ADDENDUM 3D:

JANE DOUGH SITE NUMERICAL GROUNDWATER MODELING

April 2014

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Acronyms and Abbreviations

gpd	gallons per day
gpm	gallons per minute
ID	inner (inside) diameter
ISR	In-Situ Recovery
WDEQ	Wyoming Department of Environmental Quality
WY	Wyoming

MPI.1 JANE DOUGH SITE NUMERICAL GROUNDWATER MODELING

The primary modeling approach used a version of the MODFLOW model to evaluate groundwater flow and drawdown resulting from the planned mining operations. The MODFLOW model was developed by the USGS in 1988 and has been updated and revised several times. MODFLOW-96 (Harbaugh and McDonald, 1996) was used for modeling of the groundwater system at the Jane Dough Project. The names MODFLOW and MODFLOW-96 are used interchangeably in the remainder of the addendum.

MPI.1.1 Jane Dough Project Modeling

MODFLOW-96 was used to model the groundwater flow prior to, during and after operation of the production area(s). A model grid was developed to cover the proposed mine area with a relatively fine grid (50 foot by 50 foot cells) and extending the modeled area with increased cell size to encompass approximately 5,050 square miles. The fine model grid was expanded from that described in Addendum G for the Nichols Ranch area to encompass the Jane Dough mine area. The model injection and production wells were included as well stresses within the fine grid area.

MPI.1.1.1 Model Configuration

The five layer model utilized a confined aquifer type for all five layers, with a series of general head boundaries on the perimeter of the model grid. The initial potentiometric head in each of the five layers was approximated as a uniform gradient across the model grid areas. This surface was developed using the typical gradient of 0.0033 feet/feet. The general gradient is from southeast to northwest. This initial potentiometric surface was the same as that used for the Nichols Ranch area modeling. Because the aquifer is confined, no structural information is necessary to define the groundwater system.

On the periphery of the model grid, selected cells were designated as general head boundary cells to stabilize the potentiometric surface. The head in each of the 99 designated general head boundary cells for each layer was set at the initial model head and the cell conductance was set at a relatively high level to provide a generally stable regional potentiometric surface.

MPI.1.1.1.1 Model Grid

The model grid consists of 439 rows by 244 columns and is rotated approximately 35 degrees counterclockwise from the orthogonal directions. The smallest cell dimension is 50 feet by 50 feet, and the largest cell dimension is 73,895 feet by 73,895 feet as shown in Figure MPI.1-1.

The model grid extends beyond the limits of the Wasatch aquifer on the west and southeast sides of the grid and some of the model cells are inactive. Figure MPI.1-2 presents the cells that are inactive, and also shows the initial potentiometric surface used in the modeling.

MPI.1.1.1.2 Aquifer Properties

The primary aquifer properties information used in the model included transmissivity, storage coefficient and vertical conductance. The transmissivity and storage coefficient were distinct for

each of the five layers primarily as a function of the typical layer thickness. Three distinct ore zones are identified in layers three, four and five. These ore-bearing intervals are hereafter described as upper, middle and lower ore zones. The transmissivity of layers one, two and four was set at 10.0 ft^2/day (75 gal/day/ft). The transmissivity of layers three and five was set at 8.4 ft^2/day (63 gal/day/ft). The storage coefficient for layer one was set at 6E-05 and the storage coefficient for layer two was set at 5E-05. The storage coefficient of layers three and five was set at 2E-05 and the storage coefficient of layer four was set at 3E-05. These values of storage coefficient were adjusted from the composite storage coefficient for the A sand to reflect the individual sand thicknesses.

The vertical conductance between layers is specified by the term VCONT which is the vertical hydraulic conductivity divided by the thickness between the layers and has units of day^{-1}. Because vertical continuity is profoundly reduced by even a thin layer of low permeability material, the effective values of VCONT primarily reflect the presence of shale and siltstone layers within the sequence of ore bearing sands and sandstones. VCONT was set at 1E-08 day^{-1} for the interface between layers one and two and at 2E-09 day^{-1} for the remaining layer interfaces.

MPI.1.1.1.3 Production Area Configuration

The proposed mining sequence includes two distinct production areas with an anticipated mining period of three years for Production Area #1 and a mining period of 1 1/4 years for Production Area #2. The modeled period also included the operation of two production areas in the Nichols Ranch area for a total of three years prior to mining at Jane Dough. The results of the modeling for the Nichols Ranch production areas are presented in Addendum MPG. Each production area consists of a combination of staggered recovery and injection wells arranged generally in a line drive layout for the sinuous ore body. There are areas in the ore bodies where the wells are arranged in a general 5-spot pattern. Number of wells and well locations is preliminary and may be adjusted with further delineation of the ore bodies. The well locations for the modeling are also adjusted to correspond with the center of the model cell, and the actual location may differ from the model location by up to 35 feet. Several model runs were conducted to evaluate general production area operation, and excursion control and retrieval. For the purposes of presentation, both production areas are shown with a bounding line for the upper, middle, and lower ore zones in Figures MPI.1-3, MPI.1-4, and MPI.1-5, respectively. The middle ore zone represents the largest ore body within the project area for both Production Area #1 and Production Area #2.

MPI.1.1.1.4 Operational Parameters

The anticipated recovery rate from the Production Area #1 wells is approximately 10.4 gpm. A total of 337 recovery wells were included in the full Production Area #1 operation with all wells in the middle ore zone. Total recovery rate was 3,499 gpm. Injection well operational rates ranged from 1.4 to 8.7 gpm with a total of 591 injection wells, Excess recovery or bleed rate was set at 1% of total production with a resulting injection rate of 3,465 gpm.

The anticipated recovery rate from the Production Area #2 wells is 18 gpm. A total of 195 recovery wells were included in the full Production Area #2 operation with 20 wells in the upper ore zone, 131 wells in the middle ore zone, and 44 wells in the lower ore zone. Total recovery rate was 3,500 gpm. Injection well operational rates ranged from 3.2 to 17.1 gpm with a total of

356 injection wells, with 40 wells in the upper ore zone, 235 wells in the middle ore zone, and 81 wells in the lower ore zone. Excess recovery or bleed rate was set at 1% of total recovery with a resulting injection rate of 3,464 gpm.

MPI.1.1.1.5 Stress Periods

Numerous stress periods were included to allow comparison of predicted aquifer response to the production area operations at several times during the simulation period. A transient simulation also requires very small computational time steps after each significant change in aquifer stresses including startup or shutdown of well operation. This is necessary to prevent a failure to converge in the model computation. The initial stress period was set at a very small value (0.0001 day with 5 time steps) to produce a model output result that essentially reflects initial head conditions. The stress period lengths were then gradually increased until there was a significant change in model stresses, at which point the sequence reverted to a short stress period followed by gradually increasing stress period lengths. A total of 20 stress periods were used in a total simulation period of 10.25 years which included 1.5 years of operation of each production area in the Nichols Ranch area, three years of operation of Jane Dough Production Area #1, 1.25 years of operation of Jane Dough Production Area #2, and a three year period of post-mining recovery. The Nichols Ranch production areas are included in the model sequence to provide a more complete sequence of stresses from mine operation, but the results are described in Addendum MPG and are not repeated in this addendum.

MPI.1.1.2 Model Results

The MODFLOW model produces output in terms of predicted drawdown or predicted head at selected times within the simulation. The drawdown or water-level rise is calculated as the difference between head at a selected time and the initial head for the aquifer at the start of the simulation. Both results are useful in the interpretation of aquifer response to the mining and are used to evaluate the modeling predictions.

MPI.1.1.2.1 Production Area #1

The configuration for Production Area #1 includes wells in the middle ore zone as shown in Figure MPI.1-4. The modeled potentiometric surface for all layers prior to the start of mining is presented Figure MPI.1-2. The mining operation of the recovery and injection wells is expected to continue for 36 months, after which mining of Production Area #2 begins. Figure MPI.1-6 presents the predicted drawdown contours for layer four of Production Area #1 after one year of operation. Figure MPI.1-7 presents the predicted water-level elevation contours for layer four of Production Area #1 after one year of operation. The operation of the production area at a bleed rate of 1% of the planned 3,500 gpm recovery rate has resulted in development of a significant cone of depression around the operating production area. There is also significant residual drawdown in the Nichols Ranch mining area. The area of gradient reversal in layer four extends approximately 3,000 feet to the northwest of the southwestern portion of the Production Area #1 ore body.

MPI.1.1.2.2 Production Area #2

Production Area #2 consists of injection and recovery wells in the upper, middle, and lower ore zones as shown in Figures MPI.1-3, MPI.1-4 and MPI.1-5. Because the generally sinuous ore

bodies are in the same area, there may be up to three wells completed in a single planar cell. The operation of Production Area #2 will begin after mining is completed in Production Area #1. In Production Area #2, the expected middle zone recovery constitutes 2,351 gpm of the total three layer production area recovery rate of 3,500 gpm. Because the majority of the production is from the middle ore zone, the drawdown and gradient reversal is evaluated in this layer. Figure MPI.1-8 presents the predicted potentiometric surface after 15 months of operation in Production Area #2. The area of gradient reversal to the northwest of the production area extends more than 2,500 feet from the production area.

MPI.1.1.2.3 End of Mining

The end of mining water levels and water-level changes are reflected in Figures MPI.1-8 and MPI.1-9 as described in the previous section. The planned Jane Dough area ISR project includes two adjacent production areas operated in sequence for a total period of 51 months. The area of the production areas is similar, but Production Area #1 has a larger number of operating wells. The mining operation for Production Area #1 is in the middle ore zone (layer four) and a large fraction of the total recovery rate for Production Area #2 is in the middle ore zone. The largest cone of depression for the mining operation occurs in the middle ore zone at the end of 15 months of operation of Production Area #2 (see Figures MPI.1-8 and MPI.1-9).

MPI.1.1.2.4 Extent of Drawdown

The drawdown in the middle ore zone at the end of mining is presented in Figure MPI.1-9. The middle ore zone represents significantly more than one-half of the total production area recovery rate, and when the proportioning of the aquifer storage to the ore sand thickness is considered, this ore zone represents the maximum drawdown impact on the aquifer. The extent of the drawdown is relatively large with a five foot drawdown contour extending approximately 7.5 miles to the north or northwest from the central Jane Dough mining area. The drawdown cone is elongated to north and slightly to the west and this is attributed to the mining in the Nichols Ranch area prior to mining at Jane Dough.

MPI.1.2 Horizontal Flare Evaluation

The horizontal flare around the operating well field was evaluated for the Nichols Ranch Production Area #1 as described in Addendum MPG. Based on the similarities in planned operational mining, the Nichols Ranch horizontal flare evaluation is considered applicable for the Jane Dough production areas.

MPI.1.2.1.1 Flare Evaluation

As shown in Figure MPG.1-15 of Addendum MPG, the lixiviant does flare beyond the boundary of the ore body. This horizontal flare is quantified as the ratio of the area contacted by the injectate to the area of the ore body under production area pattern. The area contacted by the injectate is represented by the contour line where there is a 0.5 unit concentration increase over the background concentration of 1.0. The ratio of the area within the 1.5 concentration contour to the area of the ore body within the well pattern is 1.19 and this is considered the horizontal flare factor. This flare factor is within the expected range of horizontal flare. There will also be a degree of vertical flare, and the composite flare factor of 1.45 includes both vertical and horizontal flare.

MPI.1.3 Excursion Control and Retrieval

The potential for excursion was considered in a MODFLOW-96 modeling scenario by adjusting modeling parameters to produce a temporary and local imbalance in production area operation. The imbalance involves either insufficient recovery rate or excess injection rate for a local area such that the local bleed rate is zero or actually negative representing more injection than recovery. Limiting this condition to a local area of a few wells is considered appropriate because a wider scale imbalance with insufficient bleed is unlikely given continuous monitoring of recovery and injection rates.

Simulation of retrieval of an excursion is essentially a reversal of the process that created the excursion. Increasing the effective bleed rate for a local area will increase the local drawdown and cause an expansion of the area of gradient reversal. Within this zone of gradient reversal, ground water will be flowing to the recovery wells and any ground water that has been impacted by mining fluids will be retrieved.

MPI.1.3.1 MODFLOW Modeling Changes

The MODFLOW-96 modeling configuration described in Section MPI.1.1.1 was used for the simulation of excursion and retrieval. The model included operation of Production Area #1 with adjustment of recovery rates from two wells in the middle ore zone to create a local imbalance resulting in excursion, followed by overproduction to affect retrieval. In the simulations, the rate adjustments were preceded by a period of normal production area operation.

The production area operation simulation included a 60 day period of normal operation with a 1% bleed rate followed by a period of local imbalance. In order to simulate a local imbalance, the extraction rate for two middle ore zone recovery wells in the southwestern portion of the production area was reduced by 5.0 gpm/well for a 60 day period. This was followed by a 60 day stress period in which the extraction rate for the two designated wells was increased by 5.0 gpm/well. This is a significant change in the well recovery rate for the two wells, but only resulted in a production area bleed rate range of 0.7 to 1.3% of total production area recovery rate. The operation for all other wells was unchanged from the previous simulations.

MPI.1.3.2 60 Day Excursion and Retrieval Simulation

The results of a MODFLOW-96 simulation of 60 days of normal production area operation are presented in Figure MPI.1-10. The cone of depression around the production area is expanding, and on the potentiometric surface is generally convergent to the production area. At the end of the initial 60 day period, the recovery rates were reduced for two wells within the area indicated in Figure MPI.1-11. At the end of 60 days with this local imbalance, there is a significant zone where gradient reversal has been lost on the west side of Production Area #1. This area where there is a potential excursion is over 900 feet wide and extends a distance of more than 1,200 feet from the production area (see Figure MPI.1-11). The reduction of recovery rates for this simulation has resulted in significant gradient away from the production area and significant potential for excursion. Based on the surface presented in Figure MPI.1-11, the potential excursion of mining fluids would be spread over a width that is much larger than the planned spacing for monitoring ring wells. Figure MPI.1-12 presents the potentiometric surface after an additional 60 day stress period with increased well recovery rates to offset the period of

excursion. A strong gradient reversal has been regained and extends over 1,000 feet to the northwest of the production area. This indicates that retrieval will be effective, and could occur at moderate rates under strong gradients.

MPI.1.3.3 Discussion of Excursion Simulation

The excursion and retrieval simulations indicate that potential excursion conditions will be produced under local but rather severe production area imbalances. The confined aquifer conditions contribute to relatively rapid changes in gradients and gradient reversal with imbalance or overproduction. The width of the zone over which gradient reversal is lost is also relatively wide at over 900 feet. Mining fluids that are migrating away from the active production area will be spread over a width that is approaching the width of the area where gradient reversal is lost, and there will be additional flare as the impacted ground water moves away from the production area. This indicates that the anticipated monitoring ring well spacing of 500 feet will be sufficient to detect potential excursions.

MPI.2 REFERENCES

Harbaugh, A.W., and M.G. McDonald, 1996, User's Documentation for MODFLOW-96, an update to the U.S. Geological Survey Modular Finite-Difference Groundwater Flow Model, U.S. Geological Survey Open-File Report 96-485, Reston Virginia.

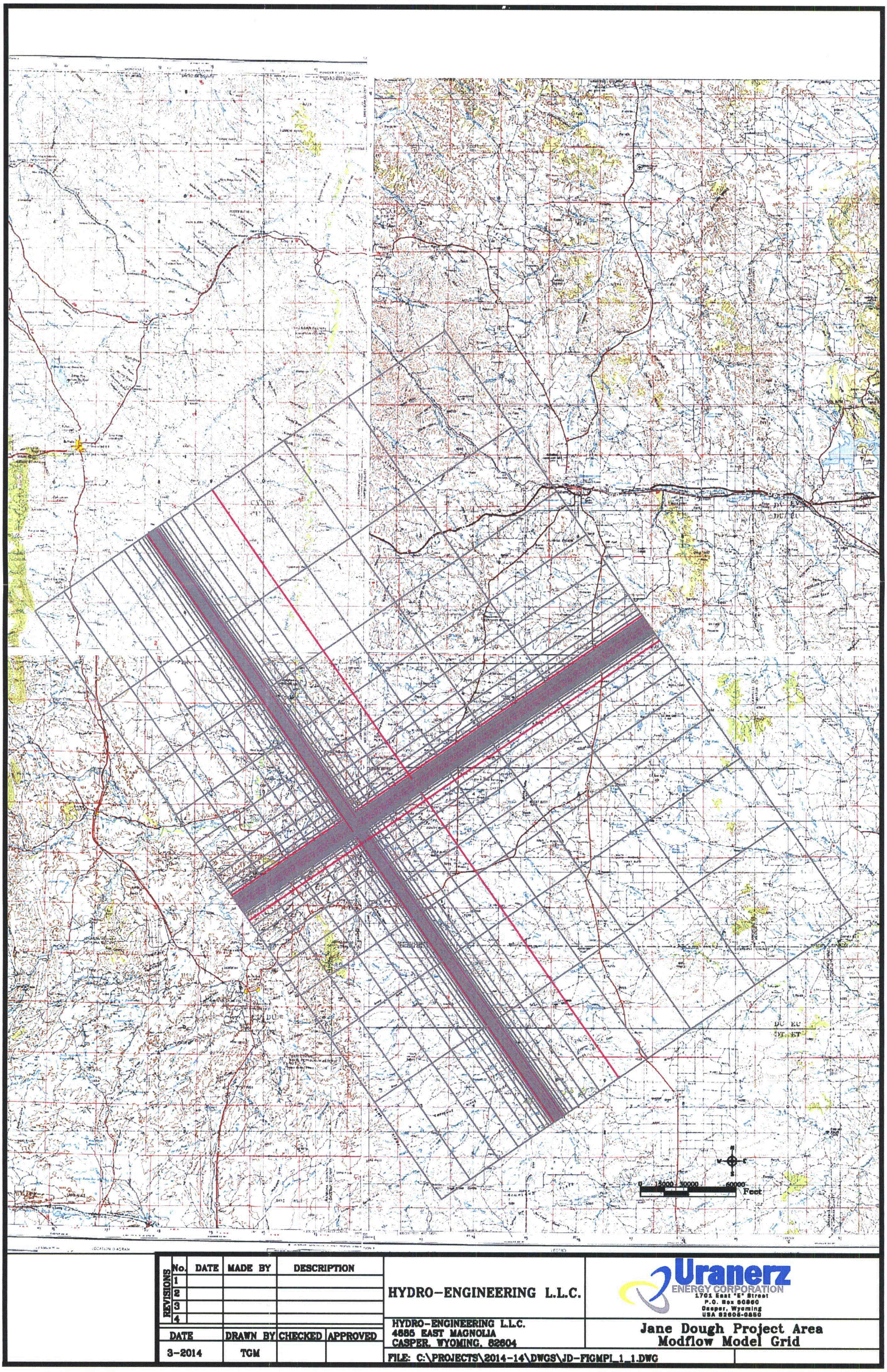
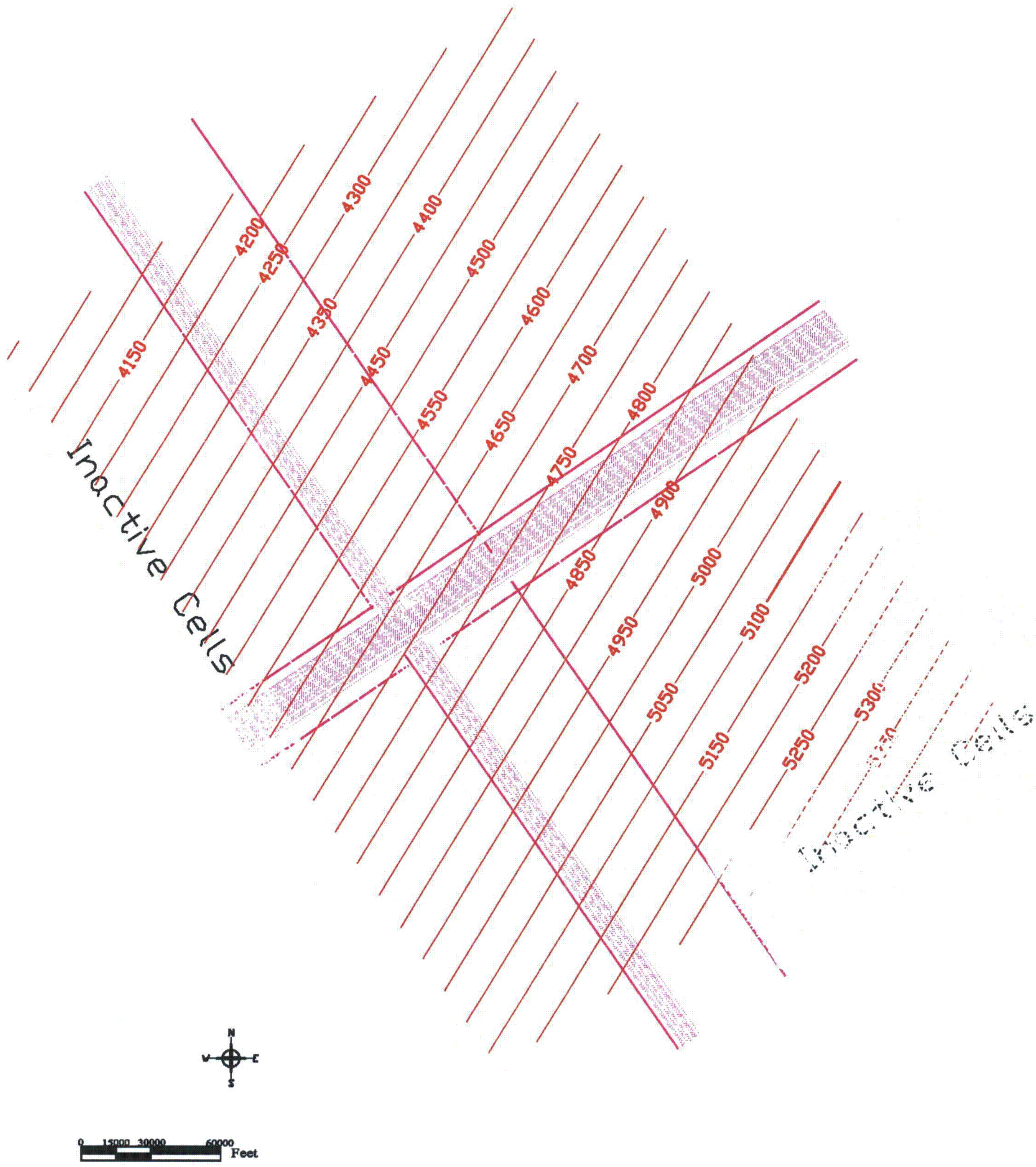


Figure MPI.1-1. Jane Dough Project Area MODFLOW Model Grid



Legend

—4915— Water-Level Elevation Contours

REVISIONS No.	DATE	MADE BY	DESCRIPTION
1			
2			
3			
4			

DATE	DRAWN BY	CHECKED	APPROVED
3-2014	TGM		

HYDRO-ENGINEERING L.L.C.

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Casper, Wyoming
USA 82605-0850

General Potentiometric Surface and Active Model Cells

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Figure MPI.1-2. General Potentiometric Surface and Active Model Cells

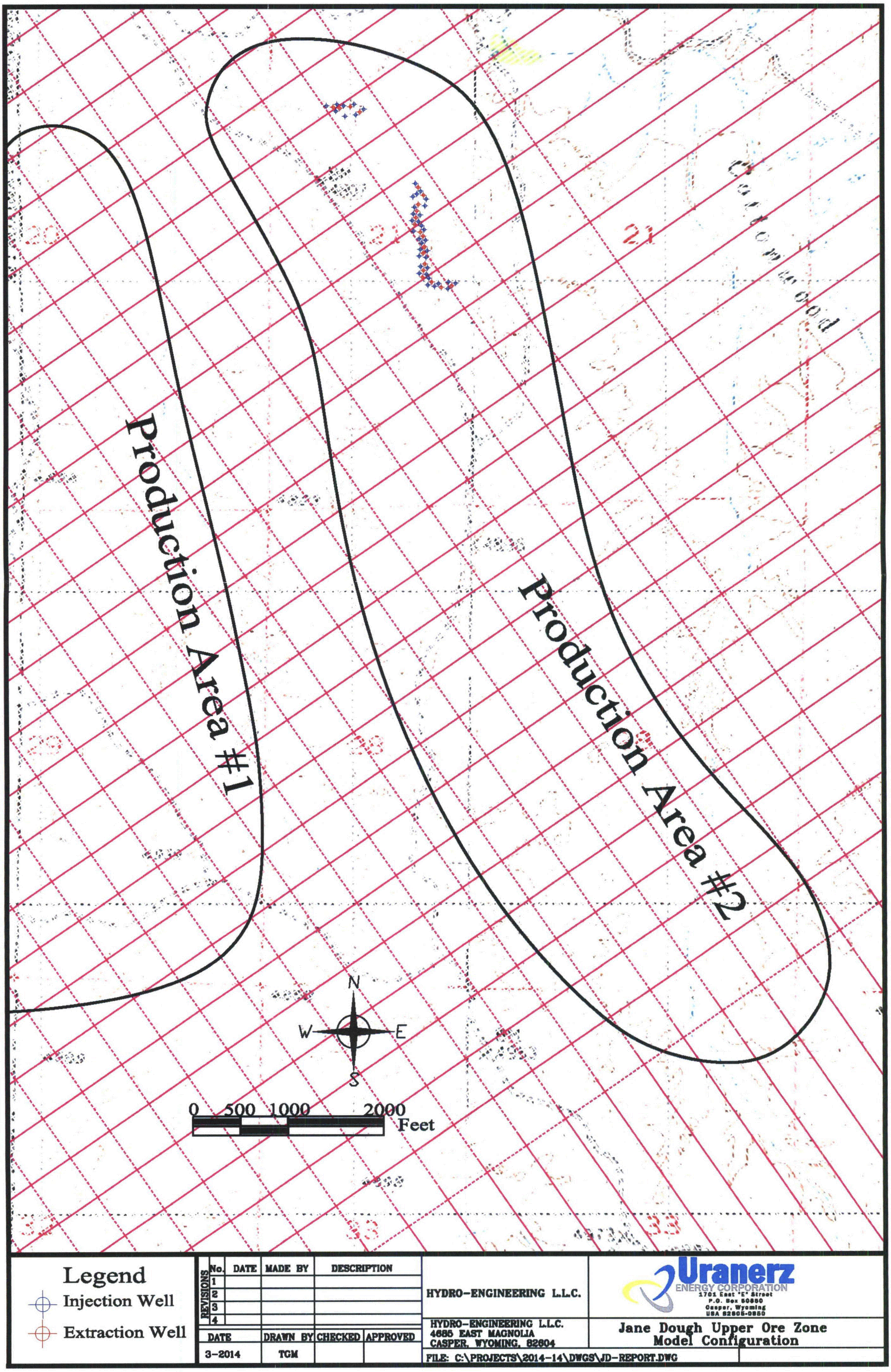


Figure MPI.1-3. Jane Dough Upper Ore Zone Model Configuration

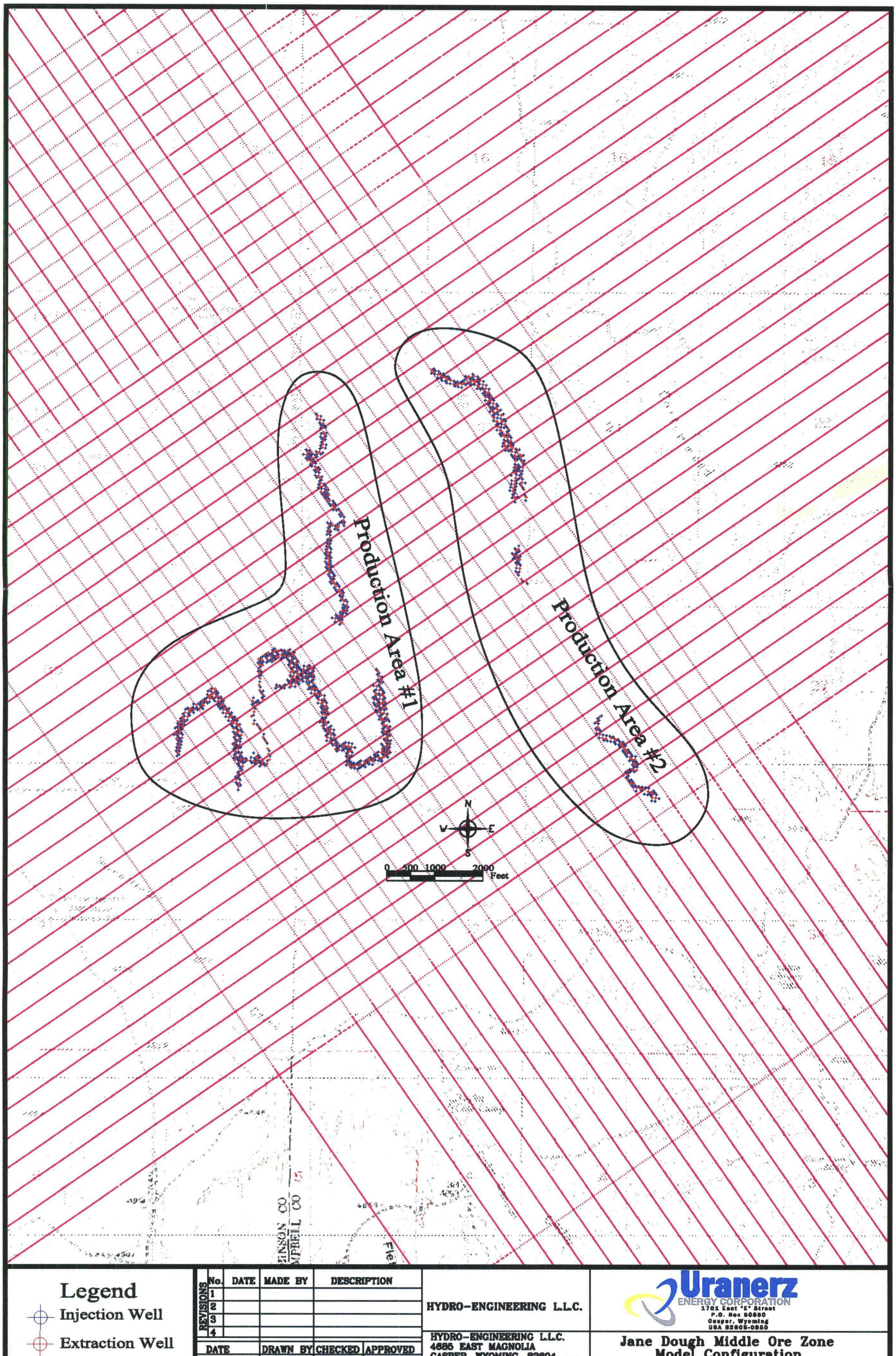


Figure MPI.1-4. Jane Dough Middle Ore Zone Model Configuration

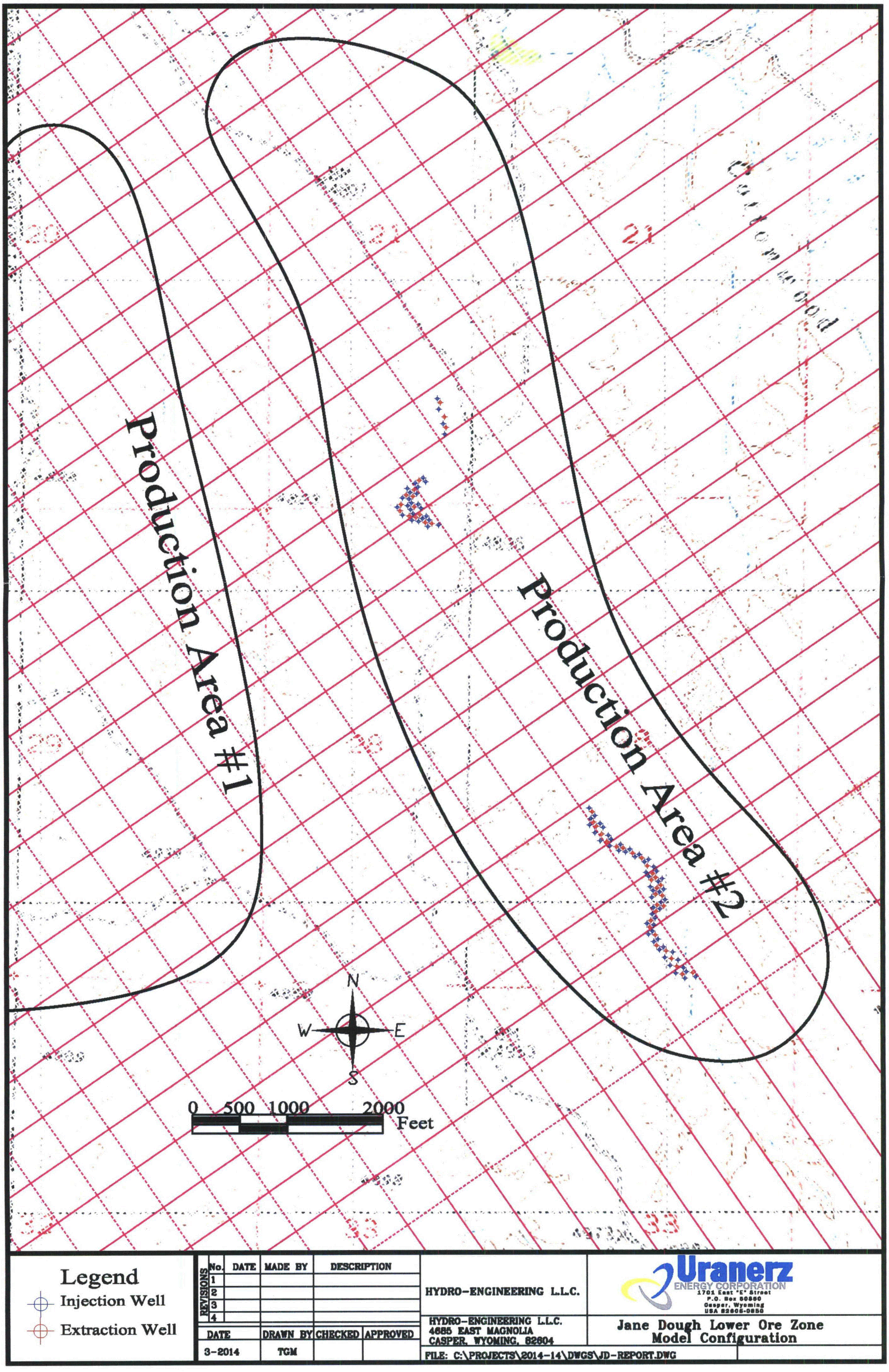


Figure MPI.1-5. Jane Dough Lower Ore Zone Model Configuration

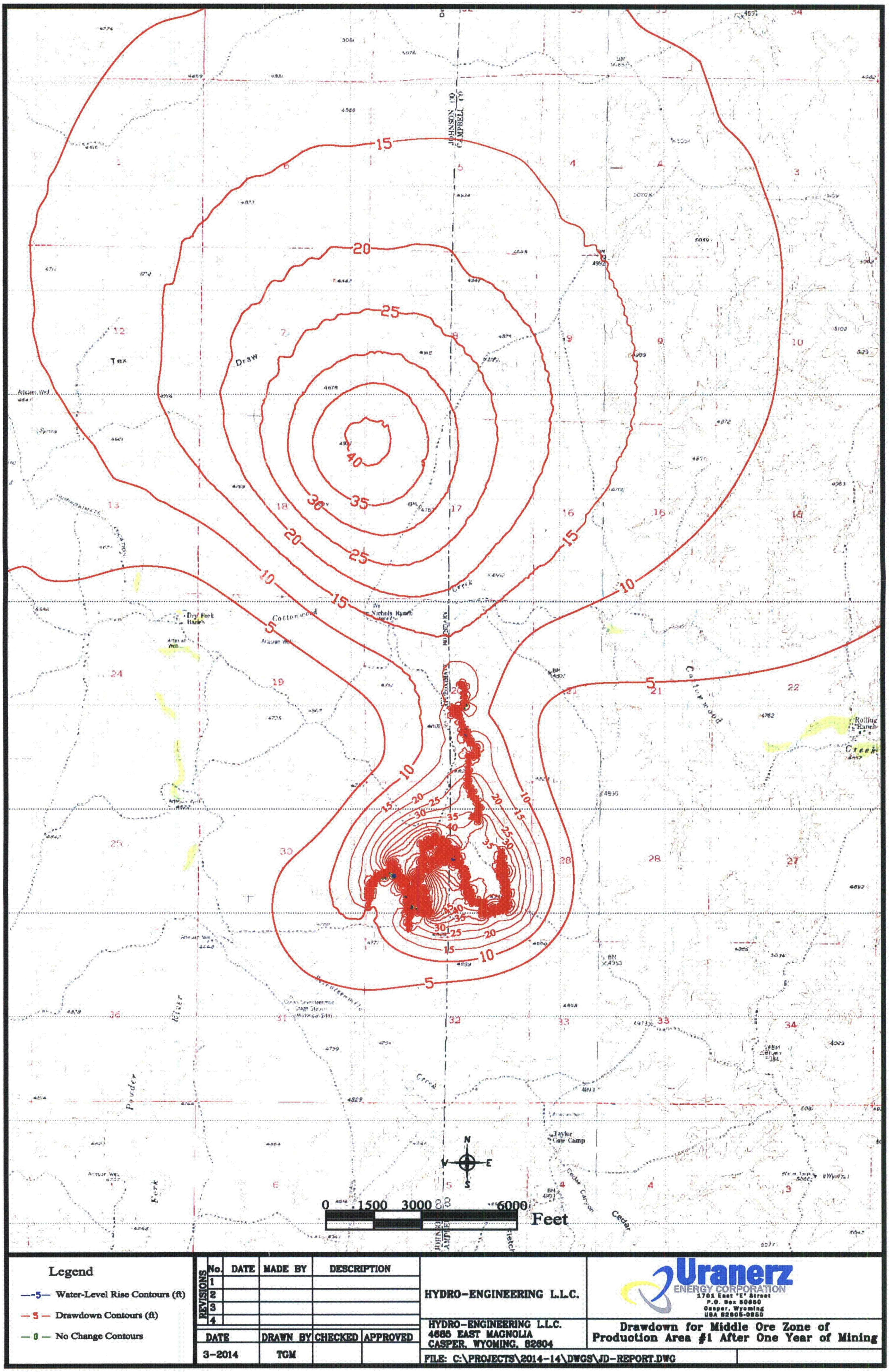


Figure MPI.1-6. Predicted Drawdown for Middle Ore Zone of Production Area #1 After One Year of Mining

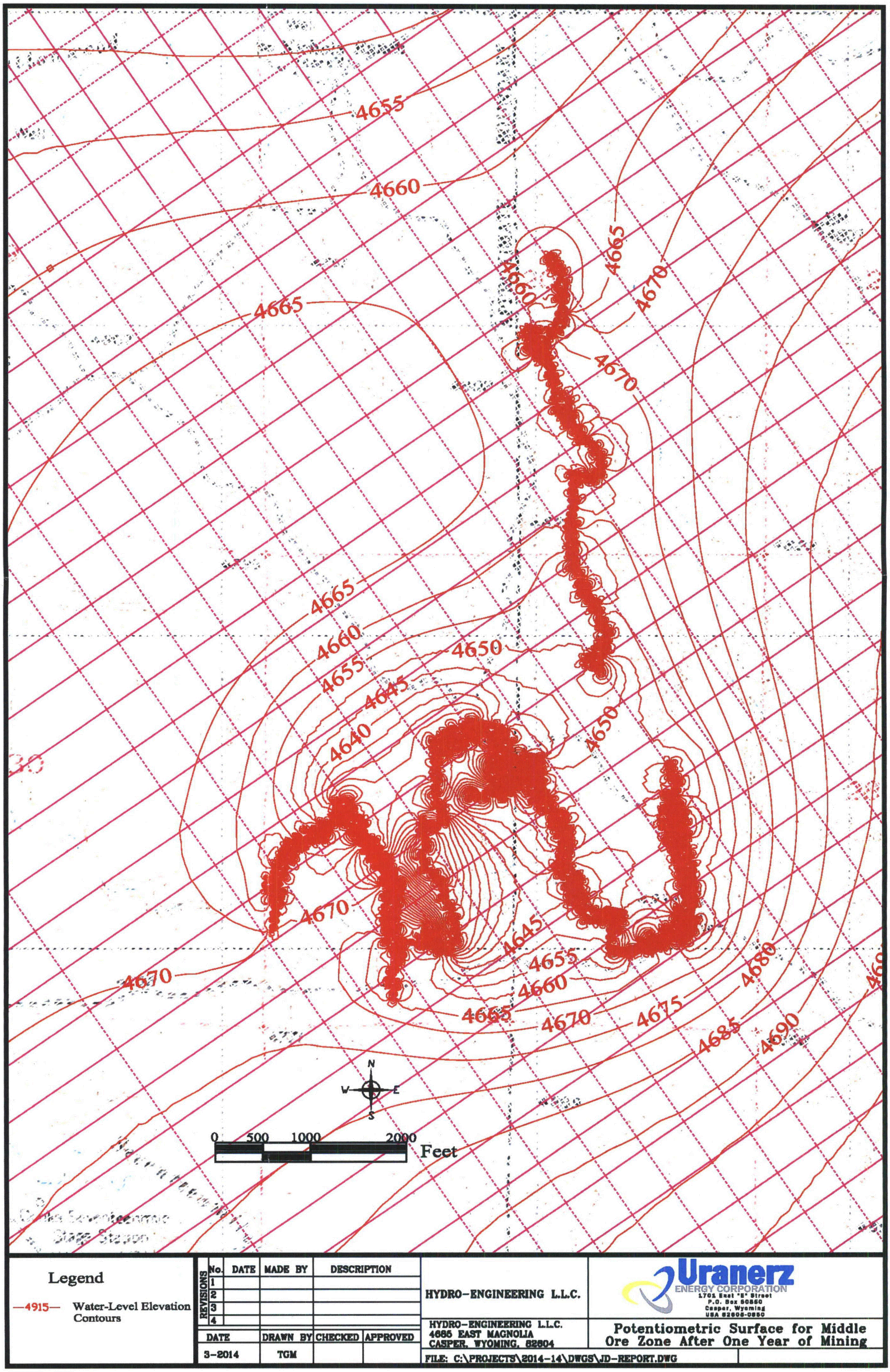


Figure MPI.1-7. Potentiometric Surface for Middle Ore Zone After One Year of Mining

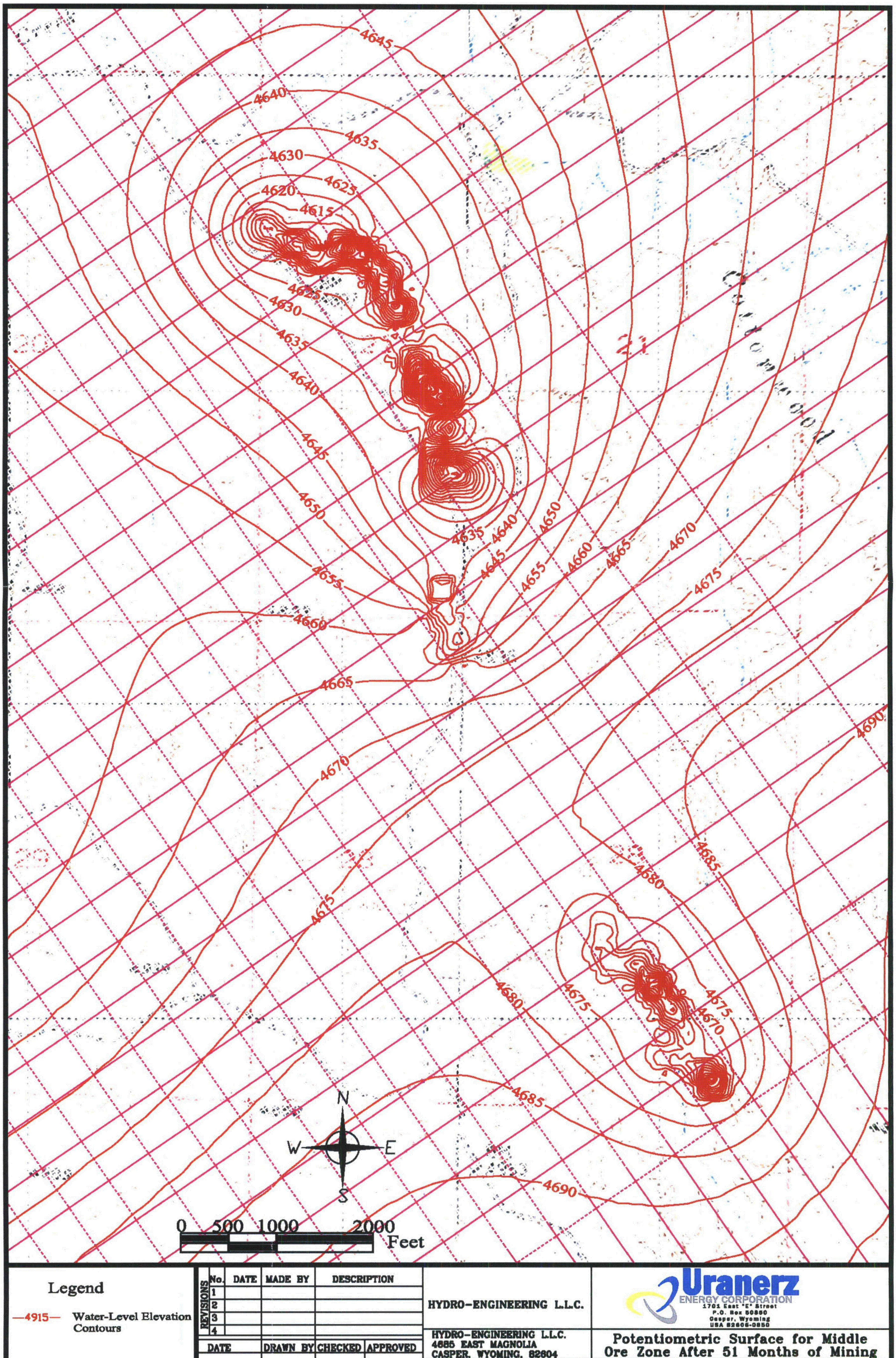


Figure MPI.1-8. Potentiometric Surface for Middle Ore Zone After 51 Months of Mining

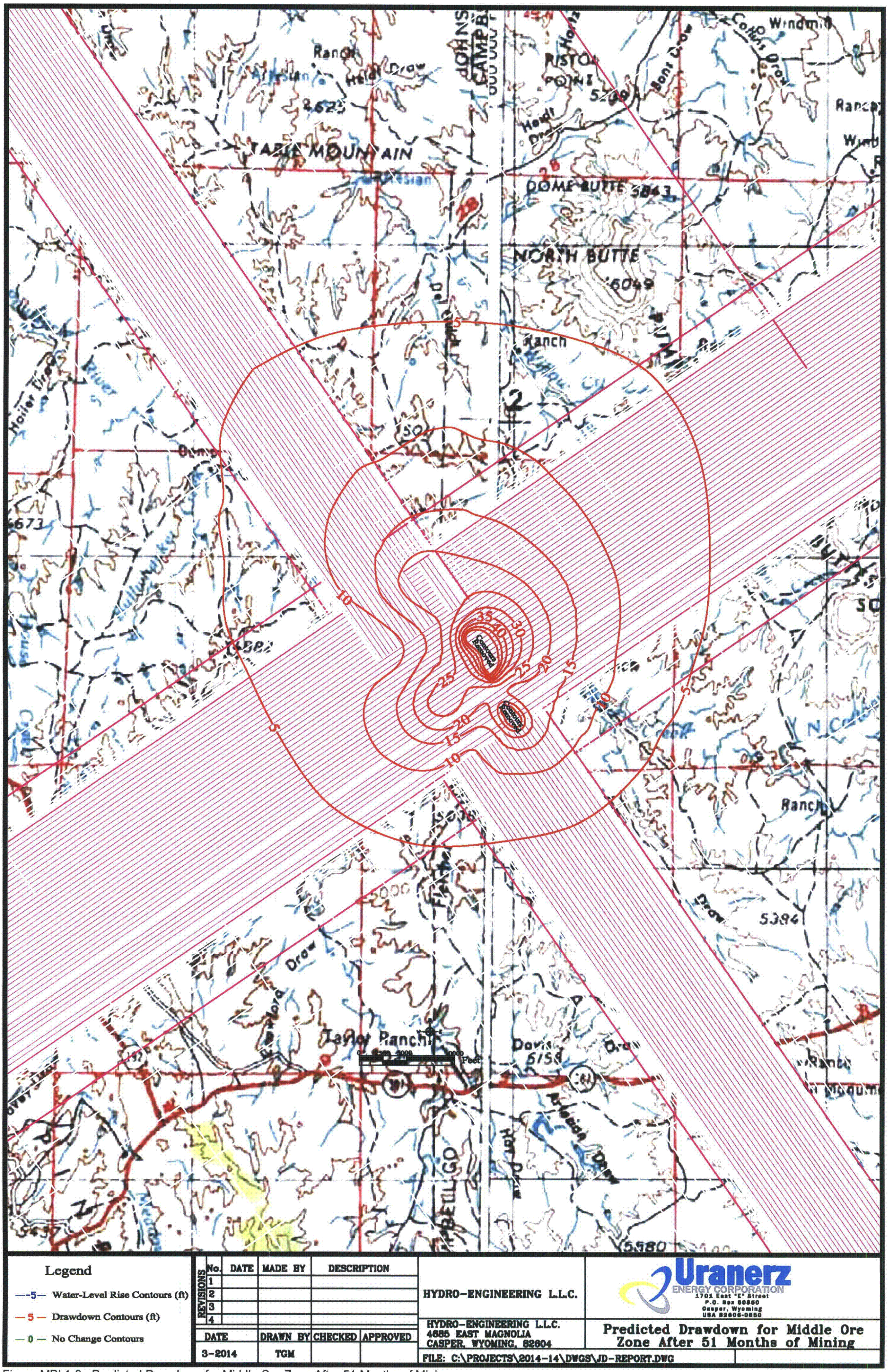
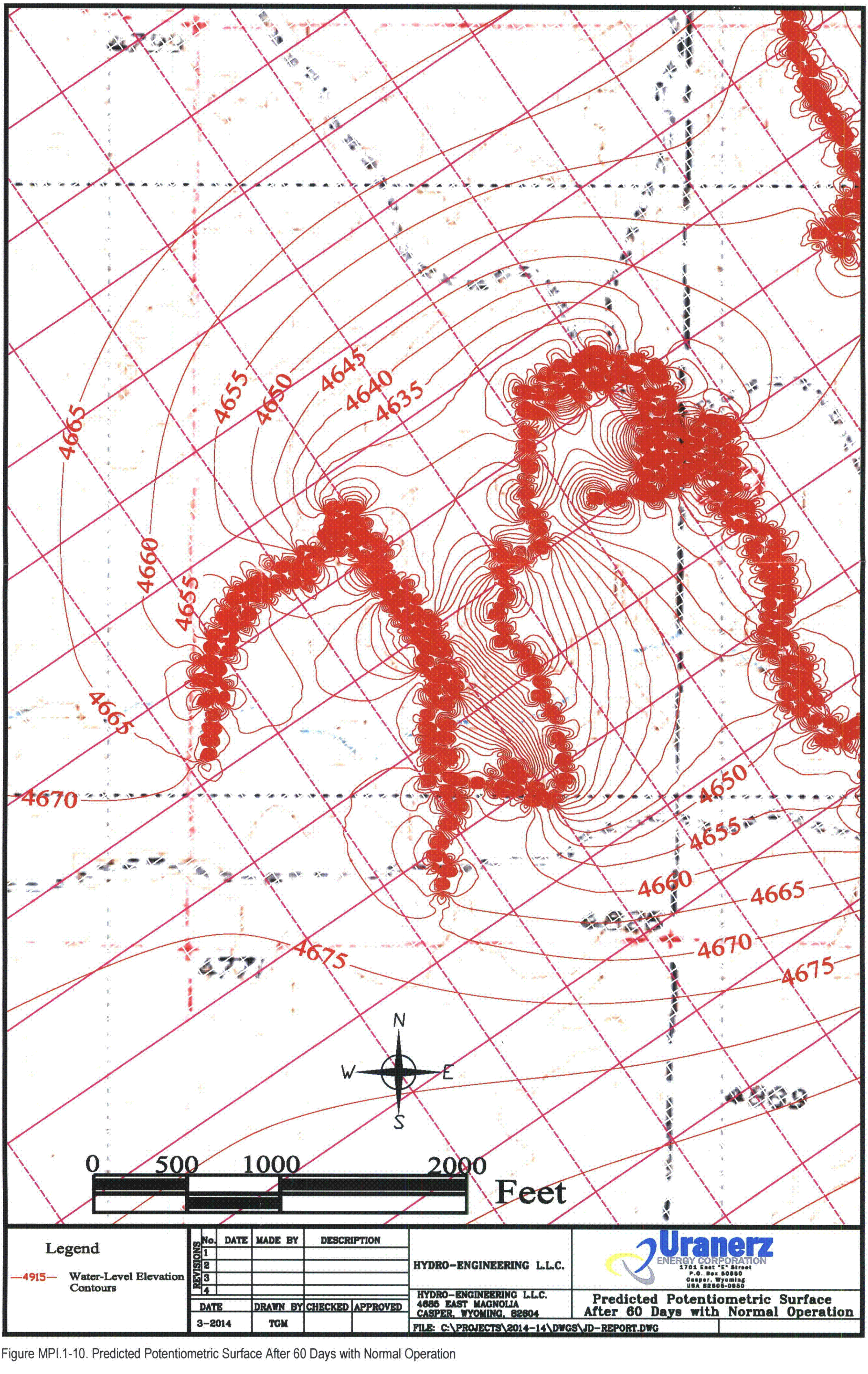


Figure MPI.1-9. Predicted Drawdown for Middle Ore Zone After 51 Months of Mining



Legend

—4915— Water-Level Elevation Contours

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DATE	DRAWN BY	CHECKED	APPROVED
3-2014	TGM		

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Predicted Potentiometric Surface After 60 Days with Normal Operation

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Figure MPI.1-10. Predicted Potentiometric Surface After 60 Days with Normal Operation

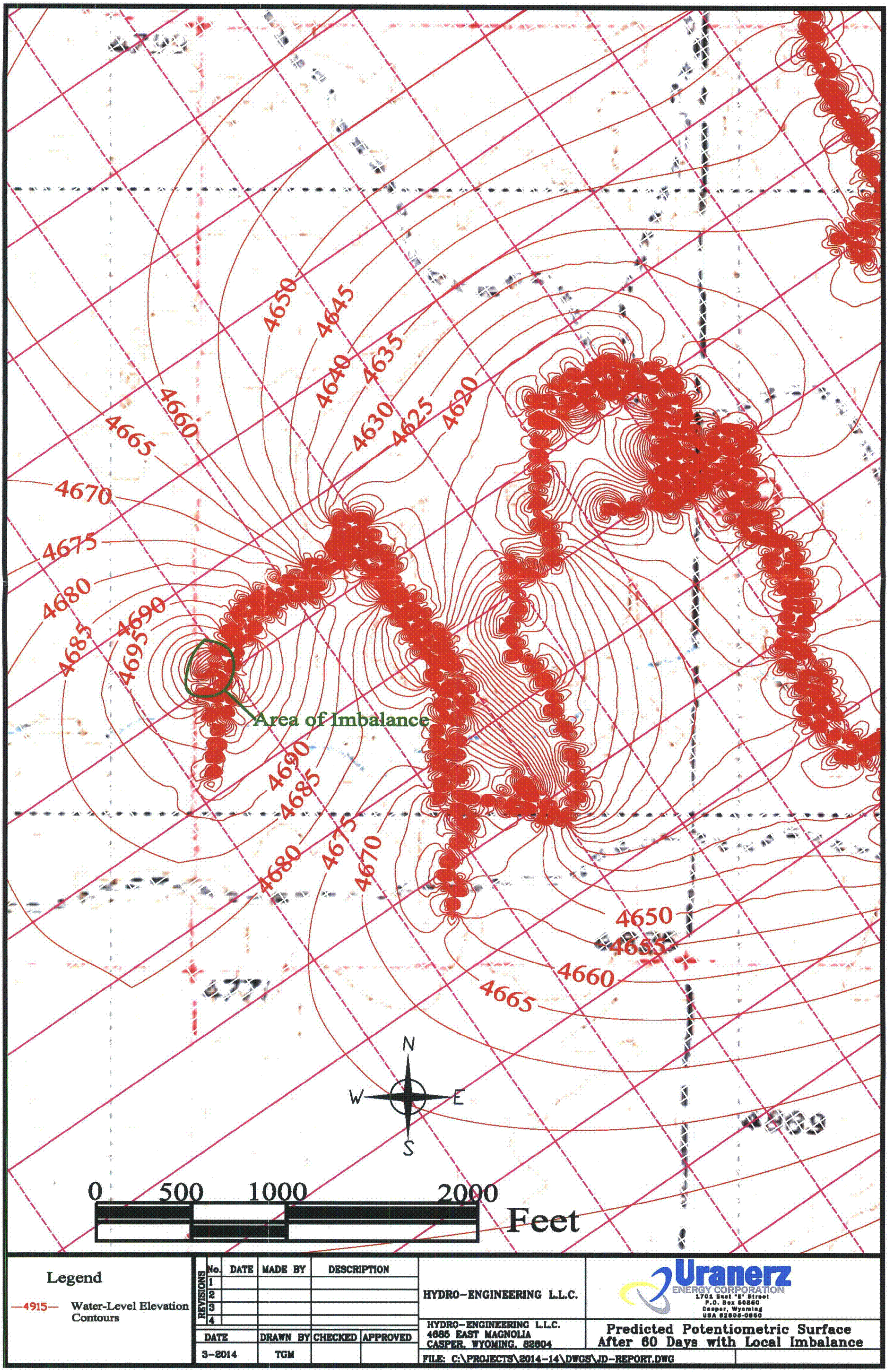

Figure MPI.1-11. Predicted Potentiometric Surface After 60 Days with Local Imbalance

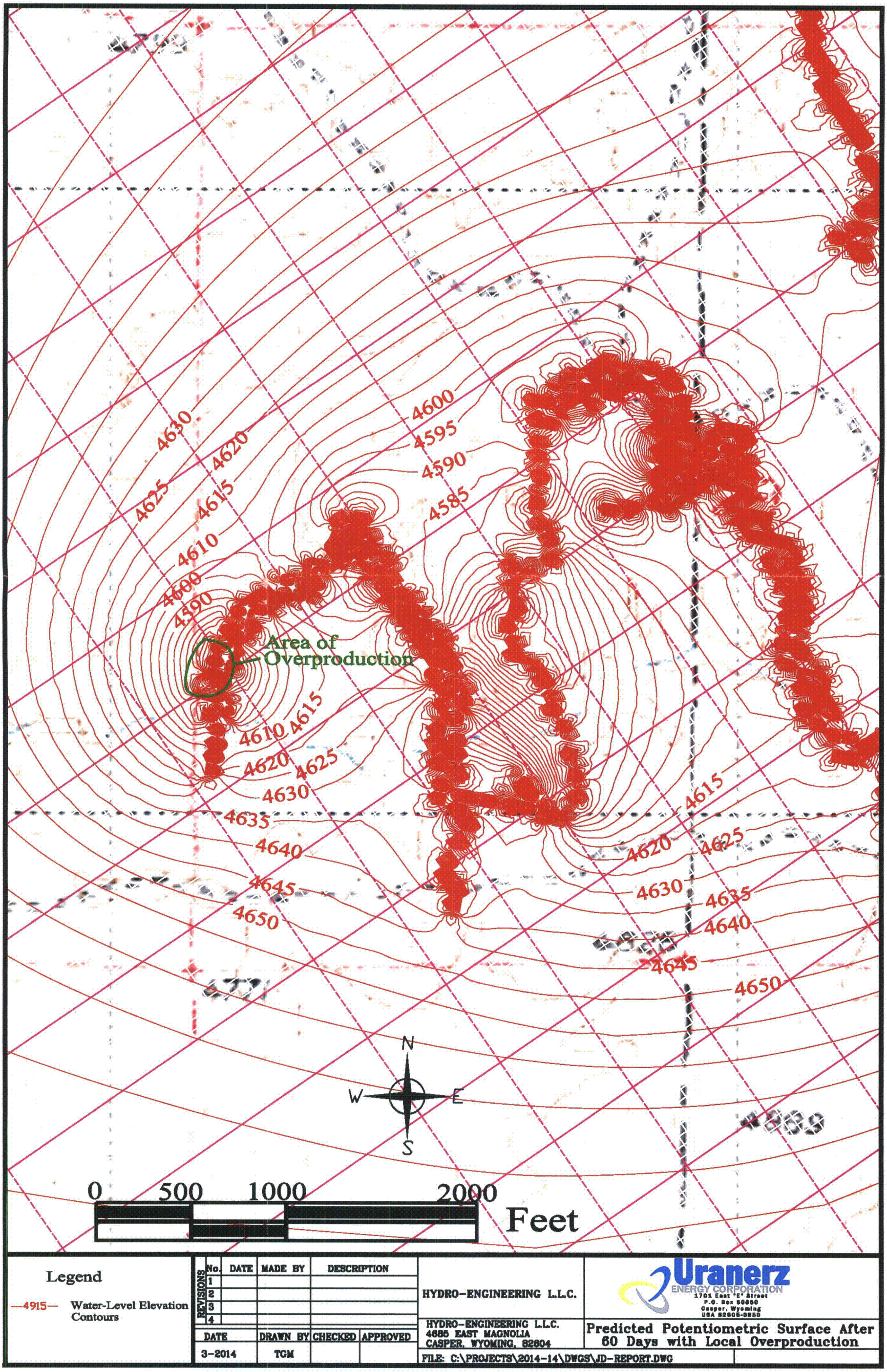

Figure MPI.1-12. Predicted Potentiometric Surface After 60 Days with Local Overproduction

ADDENDUM 5A:

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Addendum 6A

ADDENDUM 6A:

LANDOWNER ROAD DESIGN CONSTRUCTION LETTER

November 2007

ADDENDUM 6A:

LANDOWNER ROAD DESIGN CONSTRUCTION LETTER

November 2007

T CHAIR LAND COMPANY
1024 BROWN ROAD
GILLETTE, WYOMING 82718

November 19, 2007

Land Quality Division
Department of Environmental Quality
Sheridan, Wyoming

To Whom It May Concern:

This letter is in reference to the mine access roads being proposed by Uranerz Energy Corporation for the Nichols Ranch and Hank uranium production units.

The T Chair Land Company has its own road construction method. This is the method we want Uranerz to use pertaining to uranium mining sites. We do not favor this method because Uranerz wants it, we favor it because we want it.

I have successfully used this method of road construction previously which involves removing the top layer of good topsoil (which I believe you call the A horizon) and temporarily windrowing it to each side. Then the barrow ditch is cut with the subsoil from the ditch going onto the road bed to elevate it. This helps to keep snow from drifting on the road. The topsoil is then placed in the drainage ditch on each side of the road and reseeded. This method has been used successfully in commercial oil and gas industry for many years

I believe in this method as far as keeping the <u>good</u> topsoil in its place – on top! Reseeding takes place quicker in the topsoil which reduces wind and water erosion. I have always had a problem with mixing the 2nd layer of topsoil (B horizon) in with the good topsoil as it slows down the reseeding and the more material you move the more you are going to lose. Also, we want the amount of soil placed in storage piles and windrows to be kept to an absolute minimum. These piles result in a loss of soil from erosion plus natural grass is covered up and not available for gazing.

As a reminder, final reclamation involves the windrowing of the A horizon soil in the ditch to the outside of the backslop, removing the gravel from the road bed, ripping the road bed and placing the subsoil (B horizon) back in the ditch, ripping the road surface and ditch area again, replacing the good topsoil on top of the subsoil and reseeding. We believe that this procedure will adequately reclaim the road.

If the method being proposed for access road construction is not acceptable we want to know why. If we were going to build a temporary ranch this the method we would use. As the Landowners who's livelihood depends on good range land, we are sure that the method we use to construct roads prevents topsoil loss and will make for good reclamations when the time comes.

Also, in the unlikely event of a spill of chemical compounds on the road or side ditches we would like Uranerz to clean the affected area including the affected top soil and then replace to top soil as needed.

T-Chair Land Company

Patricia Clark
for Gene Mankin

Gene Mankin

ADDENDUM 6B:

NICHOLS RANCH ISR PROJECT SURETY ESTIMATE

Revised June 2010
November 2007

ADDENDUM 6B:

NICHOLS RANCH ISR PROJECT SURETY ESTIMATE

November 2007

Uranerz
ENERGY CORPORATION

Surety Estimate
First Year of Operation
Nichols Ranch In-Situ Recovery Project
Uranerz Energy Corporation

Total Restoration and Reclamation Cost Estimates

No.	Cost Item	Cost
1	GROUNDWATER RESTORATION COST	$2,955,240
2a	PLANT EQUIPMENT REMOVAL AND DISPOSAL COST	$213,150
2b	BUILDING DEMOLITION AND DISPOSAL COST	$911,292
3	SOIL REMOVAL & DISPOSAL COST	$234,300
4	TOTAL WELL ABANDONMENT COST	$319,234
5	WELLFIELD EQUIPMENT REMOVAL & DISPOSAL COST	$335,643
6	TOPSOIL REPLACEMENT & REVEGETATION COST	$313,978
7	MISCELLANEOUS RECLAMATION COST	$3,335
	Subtotal Restoration and Reclamation Cost Estimate	$5,286,171
	Subtotal	$5,286,171
	Administration,Overhead and Contingency (25%)	$1,321,543
	Total	$6,607,714
	TOTAL CALCULATED IN 2010 DOLLARS	$6,607,714

US DEPT. of COMMERCE PRODUCER PRICE INDEX ADJUSMENT 2007 to 2010	**5.78%**
US DEPT. of COMMERCE PRODUCER PRICE INDEX ADJUSMENT 2009 to 2010	**5.31%**

Note: Unit costs presented in the various worksheets in this estimate originally incorporated 2007 values. Subsequently, where available, unit costs from the latest version (2009) of WDEQ Guideline 12, App K were included. All unit costs, whether 2007 or 2009, were adjusted by the Producer Price Index factor for the respective data. Note that PPI was used rather than Consumer Price Index as identified during WDEQ review, as changes in producer prices are more appropriate for industrial applications than a consumer price index.

Worksheet 1, No. I --
GROUNDWATER RESTORATION

Cost Item	Mining Unit Nichols #1	Notes
Technical Assumptions		
Wellfield Area (Ft^2)	1,551,650	
Wellfield Area (Acres)	35.62	66.21 Ac at Nichols, 45.56 at Hank per URZ permit
Affected Ore Zone Area (Ft^2)	1,551,650	
Avg Completed Thickness (Ft)	7.27	
Factor for Flare	1.45	
Affected Volume:	16,356,717	
Porosity	0.3	
Gallons per Cubic Foot	7.48	
Gallon per Pore Volume	36,704,474	
Number of Wells in Unit(s)		
Recovery Wells	233	
Injection Wells	259	
Monitor Wells	33	
Average Well Spacing (Ft)	100	
Average Well Depth (Ft)	550	
I Groundwater Sweep		
A. Plant & Office		
Operating Assumptions:		
Flowrate (gpm)	50	
PV's Required	1.00	
Total Gallons for Treatment	36,704,474	
Total Kgals for Treatment	36,704	
Cost Assumptions:		
Power		
Avg Connected Hp	15	
Kwh's/Hp	0.9325	
$/Kwh	0.05	$.02 plus demand charges per quote
Gallons per Minute	50	
Gallons per Hour	3000	
Cost per Hour	$0.74	
Cost per Kgal ($)	$0.247	
Chemicals		
Barium Chloride ($/Kgals)	$0.043	Costs from operating ISR facility experience (Cogema)
Antiscalent ($/Kgals)	$0.000	Costs from operating ISR facility experience (Cogema)
Elution ($/Kgals)	$0.105	Costs from operating ISR facility experience (Cogema)
Repair & Maintenance ($/Kgals)	$0.065	Costs from operating ISR facility experience (Cogema)
Analysis ($/Kgals)	$0.173	Costs from operating ISR facility experience (Cogema)
Total Cost per Kgal	$0.63	
Total Treatment Cost	$23,223	
Utilities		
Power ($/Month)	1,904	
Propane ($/Month)	846	
Time for Treatment		
Minutes for Treatment	734,089	
Hours for Treatment	12,235	
Days for Treatment	510	
Average Days per Month	30	
Months for Treatment	17.0	
Years for Treatment	1.42	
Utilities Cost ($)	$46,735	
TOTAL PLANT & OFFICE COST	**$69,958**	
B. WELLFIELD		
Cost Assumptions:		
Power		
Avg Flow/Pump (gpm)	1	
Avg Hp/Pump	1.5	
Avg # of Pumps Required	50	
Avg Connected Hp	75	
Kwh's/Hp	0.9325	
$/Kwh	0.05289	
Gallons per Minute	50	
Gallons per Hour	3000	
Costs per Hour ($)	$3.70	
Costs per Gallon ($)	$0.0012	
Costs per Kgal ($)	$1.23	
Repair & Maintenance ($/Kgals)	$0.017	
Total Cost per Kgal	$1.250	
TOTAL WELLFIELD COST	$45,878	
TOTAL GROUNDWATER SWEEP COST	**$115,836**	

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Worksheet 1, No. II
GROUNDWATER RESTORATION

Cost Item	Mining Unit Nichols #1	Notes
II REVERSE OSMOSIS		
A. PLANT & OFFICE		
Operating Assumptions:		
Flowrate (gpm)	50	
PV's Required	6.00	
Total Gallons for Treatment	220,226,842	
Total Kgals for Treatment	220,227	
Feed to RO (gpm)	50	
Permeate Flow (gpm)	40	
Brine Flow (gpm)	10	
Average RO Recovery	80%	
Cost Assumptions:		
Power		
Avg Connected Hp	20	
kWh/Hp	0.9325	
$/Kwh	0.05289	$.02 plus demand charges per quote
Gallons per Minute	50	
Gallons per Hour	3000	
Cost per Hour ($)	$0.99	
Cost per Gallon ($)	$0.0003	
Cost per Kgal ($)	$0.33	
Chemicals		
Sulfuric Acid ($/Kgals)	$0.080	Costs from operating ISR facility experience (Cogema)
Caustic Soda ($/Kgals)	$0.117	Costs from operating ISR facility experience (Cogema)
Hydrochloric Acid ($Kgals)	$0.010	Costs from operating ISR facility experience (Cogema)
Hydrochloric Sulfide ($Kgals)	$0.322	Costs from operating ISR facility experience (Cogema)
Repair & Maintenance ($Kgals)	$0.295	Costs from operating ISR facility experience (Cogema)
Sampling & Analysis ($/Kgals)	$0.173	Costs from operating ISR facility experience (Cogema)
Total Cost per Kgal ($)	$1.33	
Total Pumping Cost ($)	$292,088	
Utilities		
Power ($/Month)	1,904	
Propane ($/Month)	846	
Time for Treatment	0	
Minutes for Treatment	4,404,537	
Hours for Treatment	73,409	
Days for Treatment	3,059	
Average Days per Month	30	
Months for Treatment	101	
Utilities Cost ($)	$276,720	
TOTAL PLANT & OFFICE COST	**$568,808**	
B. WELLFIELD		
Cost Assumptions:		
Power		
Avg Flow/Pump (gpm)	1	
Avg Hp/Pump	1.5	
Avg # of Pumps Required	72.5	
Avg Connected Hp	108.75	
Kwh's/Hp	0.9325	
$/Kwh	0.053	
Gallons per Minute	72.5	
Gallons per Hour	4350	
Costs per Hour ($)	$5.36	
Costs per Gallon ($)	$0.0012	
Costs per Kgal ($)	$1.23	
Repair & Maintenance ($/Kgals)	$0.017	
Total Cost per Kgal	$1.250	
TOTAL WELLFIELD COST	**$275,267**	
TOTAL REVERSE OSMOSIS COST	**$844,075**	

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Worksheet 1, No III --
GROUNDWATER RESTORATION

Cost Item	Mining Unit Nichols #1	Notes
III Deep Disposal Well		
Operating Assumptions:		
Total Disposal Requirement		
RO Brine Total Gallons	44,045,368	
RO Brine Total Kgallons	44,045	
Brine Concentration Factor	1	
Total Concentrated Brine (Gals)	44,045,368	
Months of RO Operation	17.0	
Average Monthly Reqm't (Gallons)	2,592,000	
Average Brine Flow (gpm)	60.0	
Total DDW Disposal (Gallons)	44,045,368	
Total DDW Disposal (Kgallons)	44,045	
Cost Assumptions:		
Avg Connected Hp	20	
Kwh's/Hp	0.9325	
$/Kwh	0.053	$.02 plus demand charges per quote
Gallons per Minute	60.0	
Gallons per Hour	3600	
Cost per Hour ($)	$0.99	
Cost per Gallon ($)	$0.0003	
Cost per Kgal ($)	$0.27	
Chemicals		
RO Antiscalent ($/Kgals)	$0.203	Costs from operating ISR facility experience (Cogema)
WDW Antiscalent ($/Kgals)	$0.239	Costs from operating ISR facility experience (Cogema)
Sulfuric Acid ($/Kgals)	$0.296	Costs from operating ISR facility experience (Cogema)
Corrosion Inhibitor	$0.230	Costs from operating ISR facility experience (Cogema)
Algacide	$0.085	Costs from operating ISR facility experience (Cogema)
Other	$0.000	Costs from operating ISR facility experience (Cogema)
Repair & Maint. ($/Kgals)	$0.243	Costs from operating ISR facility experience (Cogema)
Total Cost per Kgal	$1.570	
TOTAL DEEP DISPOSAL WELL COST	**$69,143**	

Worksheet 1, Nos. IV & V --
GROUNDWATER RESTORATION

Cost Item	Mining Unit Nichols #1	Labor Cost Factors			Notes
IV STABILIZATION MONITORING					
Operating Assumptions:					
Time of Stabilization (mos)	17.0				
Frequency of Analysis (mos)	3				
Total Sets of Analysis	6				
Cost Assumptions:					
Power ($/Month)	$0				No add'l power required to sample
Total Power Cost	$0				
Quantity of Monitoring Wells	12				
Cost per Event	$349				
Sampling & Analysis (each set)	$4,189				12 Monitoring Wells @ $330 per event
Total Sampling & Analysis Cost ($)	$25,133				
Utilities ($/Month)	$0				No add'l utilities required to sample
Total Utilities Cost ($)	$0				
TOTAL STABILIZATION COST	$25,133				
V LABOR					
Cost Assumptions:	No.	Cost/Hour	Hours/Year	Cost	
Crew:					
1. Supervisor	1	29	2080	$60,320	
2. Operators	4	22	2080	$183,040	
3. Maintenance	2	20	2080	$83,200	
4. Vehicles	2	10	2080	$41,600	
Cost per Year				$368,160	
Time Required - Years	5.02				
TOTAL RESTORATION LABOR COST	**$1,848,163**				

Worksheet 1, Nos. VI, VII & Summary --
GROUNDWATER RESTORATION

Cost Item	Mining Unit Nichols #1	Notes
VI RESTORATION CAPITAL REQUIREMENTS		
I Deep Disposal Well(s)	1	
II Plug and Abandon DDW	$52,890	
III Reverse Osmosis Unit	$0	Already in Processing Plant
TOTAL RESTORATION CAPITAL REQUIREMENTS	**$52,890**	
VII RESTORATION OF EXCURSION WELLS		
I Shallow Sand Well(s)		
Total Wells in Excursion	0	Assume no excursions during Year 1
Cost of Clean-Up	$0	
Total Shallow Sand Cleanup	$0	
II Ore Zone Wells		
Total Wells in Excursion	0	
Cost of Clean-Up	$0	
Total Ore Zone Cleanup	$0	
III Deep Zone Wells		
Total Wells in Excursion	0	
Cost of Clean-Up	$0	
Total Deep Zone Cleanup	$0	
TOTAL WELLFIELD COST		
TOTAL EXCURSION CLEANUP COST	**$0**	
SUMMARY:		
I GROUNDWATER SWEEP	$115,836	
II REVERSE OSMOSIS	$844,075	
III WASTE DISPOSAL WELL	$69,143	
IV STABILIZATION	$25,133	
SUB TOTAL	$1,054,186	
V LABOR	$1,848,163	
VI CAPITAL	$52,890	
VII EXCURSION CLEANUP	$0	
TOTAL GROUNDWATER RESTORATION COST	**$2,955,240**	

Worksheet 2 a
PLANT EQUIPMENT REMOVAL AND DISPOSAL

Cost Item	Nichols Mine Unit							Notes
	Office & Laboratory	Main Process Building	Maintenance Building	Resin + Sand Filter Media	External Tanks	Header Houses	Sub Total	
Volume (Yds^3)	40	200	45	110	109	240		add 4 add'l 17,000 gal tanks. 84 cy each crushed to 21 cy.
Quantity per Truck Load (Yds^3)	20	20	20	20	20	20		
Number of Truck Loads	2	10	2.25	5.5	5.45	12		
I Decontamination Cost								
Decontamination Cost ($/Load)	634.68	634.68	634 68	634.68	634.68	634.68		
Percent Requiring Decontamination	20%	100%	20%	0%	50%	100%		
Total Cost	$254	$6,347	$286	$0	$1,730	$7,616		
II Dismantle and Loading Cost								
Cost per Truck Load ($)	$846	$846	$846	$846	$846	$846		
Total Cost	$1,692	$8,462	$1,904	$4,654	$4,612	$10,155		
III Oversize Charges								
Percent Requiring Permits	40%	40%	40%	0%	50%	40%		
Cost per Truck Load ($)	$423	$423	$423	$423	$423	$423		
Total Cost	$338	$1,692	$381	$0	$1,153	$2,031		
IV Transportation & Disposal								
A. Landfill								
Percent to be Shipped	90%	80%	90%	0%	100%	80%		
Distance (Miles)	75	75	75	75	75	75		
Transport Cost ($/Ton-Mile)	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16		
Transportation Cost	$463	$2,058	$521	$0	$1,401	$2,468		
Disposal Fee per Cubic Yard	$65	$65	$65	$65	$65	$65		
Disposal Cost ($)	$2,323	$10,324	$2,613	$0	$7,033	$12,389		
Total Cost	$2,786	$12,380	$3,134	$0	$8,434	$14,857		
B. Licensed Site								
Percent to be Shipped	10%	20%	10%	100%	0%	20%		
Distance (Miles)	160	160	160	160	160	160		
Transport Cost ($/Ton-Mile)	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16		
Transport Cost	$691	$6,912	$778	$19,008	$0	$8,294		
Disposal Cost ($/Ton)	$370	$370	$370	$370	$370	$370		
Quantity per Truck Load (Yds^3)	20	20	20	20	20	20		
Quantity per Truck Load (Tons)	21.6	21.6	21.6	21.6	21.6	21.6		Based on avg 80lbs per cf
Disposal Cost	$1,599	$15,994	$1,799	$43,983	$0	$19,193		
Total Cost	$2,291	$22,906	$2,577	$62,991	$0	$27,487		
Total Cost	$5,076	$35,286	$5,711	$62,991	$8,434	$42,344		
TOTAL COST NICHOLS RANCH MINE	**$7,361**	**$51,788**	**$8,281**	**$67,646**	**$15,929**	**$62,146**	**$213,150**	

Worksheet 2 b --
BUILDING DEMOLITION AND DISPOSAL

Cost Item	Nichols Mine Unit Office & Laboratory	Main Process Building	Maintenance Building	Header Houses	Sub Total	Notes
STRUCTURE DEMOLITION & DISPOSAL						
Structural Character						
Demolition Volume (Ft^3)	90,000	1,188,000	144,000	3,000		
Unit Cost of Demolition ($/ Ft^3)	$0.257	$0.257	$0.257	$0.257		Demolition Unit Cost per WDEQ Guideline No.12, App. K ($/ft3)
Total Demolition Cost	$23,126	$305,264	$37,002	$771		
Weight of Disposal Material in Tons	41	535	65	1		
Factor for Gutting	0.1	0.3	0.2	0.25		
Cost for Gutting ($)	$2,313	$91,579	$7,400	$193		
Quantity per Truck Load (Ton)	21.6	21.6	21.6	21.6		
Number of Truckloads	1.9	24.8	3.0	0.1		
Distance to Landfill	75	75	75	75		
Unit Cost (Ton-Mile)	$0.16	$0.16	$0.16	$0.16		
Transportation Cost	$481.96	$6,361.87	$771.14	$16.07		
Disposal Cost ($/ton)	$102.89	$102.89	$102.89	$102.89		Demolition Unit Cost per WDEQ Guideline No.12, App. K, Adjusted Cost per Unit
Disposal Cost ($)	$4,166.96	$55,003.86	$6,667.13	$138.90		
TOTAL STRUCTURE DEMO & DISPOSAL	**$30,088**	**$458,209**	**$51,840**	**$1,119**	**$541,256**	
CONCRETE DECONTAMINATION, DEMO & DISPOSAL						
Area	9000	29700	8000	3000		12 header houses @250 sq ft each
Average Thickness (Ft)	0.5	0.5	0.5	0.5		
Volume (Ft^3)	4500	14850	4000	1500		
Weight of Disposal Concrete Assuming 145lbs/cubic foot	652,500	2,153,250	580,000	217,500		
Weight of Disposal in Tons	326	1077	290	109		
Percent Requiring Decontamination	0%	100%	0%	10%		
Volume Decontaminated (Ft^2)	0	14,850	0	150		
Decontamination ($/$Ft^2$)	$0.301	$0.301	$0.301	$0.301		Decontamination by Steam Cleaning (137.5 ft2/hr) ECHOS Unit Cost Book
Decontamination Cost	$0	$4,469	$0	$45		
Demolition ($/$Ft^2$)	$5.05	$5.05	$5.05	$5.05		Demolition Unit Cost per WDEQ Guideline No.12, App. K, Adjusted Cost per Unit
Demolition Cost	$45,494	$150,130	$40,439	$15,165		
Transportation & Disposal						
A. Onsite Disposal						
Percent to be Disposed Onsite	100%	75%	100%	100%		
Transportation Cost	$0	$0	$0	$0		
Disposal Cost per Cubic Yard ($)	$8.49	$8.49	$8.49	$8.49		Demolition Unit Cost per WDEQ Guideline No.12, App. K, Adjusted Cost per Unit
Disposal Cost ($)	$1,415	$4,668	$1,257	$472		
B. Licensed Site						
Percent to be Shipped	0%	25%	0%	0%		
Distance (Miles)	160	160	160	160		
Unit Cost (Ton-Mile)	$0.16	$0.16	$0.16	$0.16		
Transportation Cost ($)	$0	$6,833	$0	$0		
Disposal Cost ($/Ton)	$370	$370	$370	$370		
Disposal Cost ($)	$0	$99,650	$0	$0		
TOTAL TRANSPORT & DISPOSAL COST	**$46,909**	**$265,750**	**$41,697**	**$15,681**	**$370,037**	
TOTAL BUILDING DEMO & DISPOSAL COST	**$76,998**	**$723,959**	**$93,537**	**$16,800**	**$911,292**	

Worksheet 3 b --
SOIL REMOVAL & DISPOSAL

	Nichols Mine Unit					
Cost Item	Office & Laboratory	Main Process Building	Maintenance Building	Header Houses	Sub Total	Notes
SOIL EXCAVATION, TRANSPORT & DISPOSAL						
Removal Under Building Footprints						
Excavation, Front End Loader	$52	$172	$46	$17		$89.04/hr per WDEQ Guideline12 and 150 cy/hr
Quantity to be Shipped (Ft^3)	2,250	7,425	2,000	750		Assume removal of 3" of Contaminated Soil under Primary Areas, Disposal at a Licensed facility (ft3)
Weight in Tons	112.5	371.25	100	37.5		
Distance (Miles)	160	160	160	160		
Transportation Unit Cost (Ton/Mile)	$0.16	$0.16	$0.16	$0.16		
Transportation Cost	$2,856	$9,425	$2,539	$952		
Disposal Fee ($/Ton)	$370	$370	$370	$370		
Disposal Cost ($)	$41,651	$137,448	$37,023	$13,884	$230,005	
Removal NPDES Pts.						
Quantity to be Shipped (Ft^3)	0	0	0	0		Zero discharge facility
Weight in Tons	0	0	0	0		
Distance (Miles)	160	160	160	160		
Transportation Cost Ton/Mile ($)	$0.16	$0.16	$0.16	$0.16		
Transportation Cost	$0	$0	$0	$0		
Disposal Fee ($/Ton)	$370	$370	$370	$370		
Disposal Cost ($)	$0	$0	$0	$0		
Total NPDES Removal Cost	$0	$0	$0	$0	$0	
TOTAL SOILS EXC., TRANSPORT & DISPOSAL	**$41,651**	**$137,448**	**$37,023**	**$13,884**	**$230,005**	
RADIATION SURVEY						
Area Required (Acres)	0.21	0.68	0.18	0.07		
Survey Cost ($/Acre)	$635	$635	$635	$635		
Number of Structures	1	1	1	12		
Cost per Structure ($)	$238	$238	$238	$238		
TOTAL RAD SURVEY COST	**$369**	**$671**	**$355**	**$2,900**	**$4,294**	
TOTAL SOIL REMOVAL & DISPOSAL COST	**$42,020**	**$138,119**	**$37,378**	**$16,783**	**$234,300**	

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Worksheet 4 --
Well Abandonment

Cost Item	Mining Unit Nichols #1	Notes
Number of Wells	515	Includes injection, recovery and monitor wells.
Average Depth (ft)	550	
Average Diameter (inch)	5	
Area of Annulus (ft^2)	0.1364	
Materials		
Bentonite Chips Required (Ft^3/Well)	40.9	300 feet of clay above water
Bags of Chips Required/Well	55	
Cost per Bag ($)	$6.82	
Cost/Well Bentonite Chips ($)	$375	
Gravel Fill Required (Ft^3/Well)	34.1	Avg depth less 300 feet filled w/ gravel
Cost of Gravel/Yd^3 ($)	$21	
Cost/Well Gravel Fill ($)	$27	
Cement Cone/Markers Req'd/Well	1	
Cost of Cement Cones Markers ($)	$6.35	
Total Materials Cost per Well	$408	
Labor		
Hours Required per Well	2	
Labor Cost per Hour	$74	
Total Labor Cost per Well ($)	148.092	
Equipment Rental		
Hours Required per Well	1	
Backhoe w/Operator Cost/Hr ($)	$63	
Total Equipment Cost per Well ($)	$63	
Total Cost per Well ($)	$620	
TOTAL WELL ABANDONMENT COST ($)	**$319,234**	

Worksheet 5, No. I --
WELLFIELD EQUIPMENT REMOVAL & DISPOSAL

Cost Item	Mining Unit Nichols #1	Notes
I Wellfield Piping		
A. Removal		
Total Number of Wells	482	Includes total injection and recovery wells
Feeder lines from HH to Injection wells 1" HDPE (Ft)	71,560	From Preliminary Design
Pregnant solution feeder lines from production wells to HH 1" HDPE (Ft)	50,427	From Preliminary Design
Total Quantity of 1" HDPE Piping (Ft)	121,987	
Plastic Volume (Ft^3)	400.05	Thickness Based on WL Plastics Corp PSI 160 (R1=.05479', R2=.04425')
Chipped Volume Assuming 30% Void Space (Ft^3)	520.07	
Disposal Weight (tons)	20.80	Year 1 buildout only to include Nichols 1
Quantity per Truck Load (Tons)	21.6	Based on 20 cy per truckload and 80lbs per cf
Total Number of Truck Loads	1	
Total Length of Feeder line Trench (ft)	40,765	Includes Shared Trenches
Pipeline Removal Unit Cost ($/ft of trench)	$2.38	Quote - Jordan Construction
Total Cost for Trunkline Removal ($)	$97,022	
Total Cost - Removal	$97,022	
B. Survey & Decontamination		
Percent Requiring Decontamination	0	No survey or decon needed. Total volume to low level disposal
Loads for Decontamination	0	
Cost for Decontamination ($/Load)	$635	
Cost for Decontamination ($)	$0	
C. Transport & Disposal		
1.) Landfill		
a. Transportation		
Percent to be Shipped	0%	
Loads to be Shipped	0	
Distance (Miles)	75	
Transportation Cost (Ton/Mile) ($)	$0.16	
Transportation Cost ($)	$0	
b. Disposal		
Disposal Fee per Yd^3	$65	
Yds^3 per Load	20	
Disposal Cost ($)	$0	
Total Cost - Landfill	$0	
2.) Licensed Site		
a. Transportation		
Percent to be Shipped	100%	
Loads to be Shipped	1	
Tons to be Shipped	20.80	
Distance (Miles)	160	
Transportation Ton/Mile ($)	$0.16	
Transportation Cost ($)	$528	
b. Disposal		
Disposal Fee per ton	$370	
Disposal Cost ($)	$7,702	
Total Cost - Licensed Site	$8,230	
Total Cost - Transport & Disposal	$8,230	
Total Cost - WF Piping Removal & Disposal	**$105,251**	

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Worksheet 5, No. II
WELLFIELD EQUIPMENT REMOVAL & DISPOSAL

Cost Item	Mining Unit Nichols #1	Notes
II Production Well Pumps		
A. Pump and Tubing Removal		
Number of Production Wells	233	
Cost of Removal ($/well)	$42	
Cost of Removal ($)	$9,859	
Number of Pumps per Truck Load	180	
Number of Truck Loads (Pumps)	1.29	
Weight of Pumps	21.29	Assume 20 T per truck
B. Survey & Decontamination (Pumps)		
Percent Requiring Decontamination	50%	
Loads for Decontamination	0.65	
Cost for Decontamination ($/Load)	$635	
Cost for Decontamination ($)	$411	
C. Tubing Volume Reduction & Loading		
Length per Well (Ft)	300	
Total Quantity (Ft^3)	229.2	Thickness Based on WL Plastics Corp PSI 160 (R1=.05479', R2=.04425')
Chipped Volume Assuming 30% Void Space (Ft^3)	298.0	
Cost of Removal ($/Ft)	$0.03	
Cost of Removal ($)	$9.52	
Quantity per Truck Load (Ft^3)	540	
Number of Truck Loads	0.42	
D. Transport & Disposal		
1.) Landfill		
a. Transportation		
Percent to be Shipped (Pumps)	50%	
Loads to be Shipped	0.6	
Distance (Miles)	75	
Transportation Ton/Mile ($)	$0.16	
Transportation Cost ($)	$166	
b. Disposal		
Disposal Fee per Yd^3	$65	
Yds^3 per Load	20	
Disposal Cost ($)	$835	
Total Cost - Landfill	$1,002	
2.) Licensed Site		
a. Transportation		
Percent to be Shipped (Pumps)	50%	
Percent to be Shipped (Tubing)	100%	
Loads to be Shipped	1.07	
Distance (Miles)	160	
Transportation Ton/Mile ($)	$0.16	
Transportation Cost ($)	$588	
b. Disposal		
Disposal Cost per Yd^3	$18.51	
Disposal Volume per Load (cy)	20	
Disposal Cost	$397	
Total Cost - Licensed Site	$984	
Total Cost - Transport & Disposal	$1,986	
Total Cost - Pump Removal & Disposal	**$12,265**	

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Worksheet 5, No. III
WELLFIELD EQUIPMENT REMOVAL & DISPOSAL

Cost Item	Mining Unit Nichols #1	Notes
III Buried Trunkline		
A. Removal		
Trunk lines from Resin Plant to HH 8" HDPE Pipe (Ft)	38,473	
Pregnant solution trunk lines form HH to Resin Plant 8" HDPE Pipe (Ft)	38,473	
Total Quantity of 8" HDPE Piping (Ft)	76,946	
Plastic Volume (Ft^3)	51,906	Thickness Based on WL Plastics Corp PSI 160 (R1=.7188', R2=.5494')
Chipped Volume Assuming 30% Void Space (Ft^3)	67,478	
Disposal Tons	320	8.315lb/ft per WL Plastics
Quantity per Truck Load (Tons)	21.6	
Total Number of Truck Loads	15	
Total Length of Trunkline Trench (ft)	38,473	
Pipeline Removal Unit Cost ($/ft of trench)	$2.38	Quote Jordan Construction
Total Cost for Trunkline Removal ($)	$91,568	
B. Survey & Decontamination		
Percent Requiring Decontamination	0	No survey or decon needed. Total volume to low level disposal
Loads for Decontamination	0	
Cost for Decontamination ($/Load)	$635	
Cost for Survey & Decontamination ($)	$0	
C. Transportation & Disposal		
1.) Landfill		
a. Transportation		
Percent to be Shipped	0%	
Loads to be Shipped	0	
Distance (Miles)	75	
Transportation Cost (Ton/Mile) ($)	$0.16	
Transportation Cost ($)	$0	
b. Disposal		
Disposal Fee per Yd^3	$65	
Yds^3 per Load	20	
Disposal Cost ($)	$0	
Total Cost - Landfill	$0	
2.) Licensed Site		
a. Transportation		
Percent to be Shipped	100%	
Loads to be Shipped	15	
Tons to be Shipped	319.90	
Distance (Miles)	160	
Transportation Ton/Mile ($)	$0.159	
Transportation Cost ($)	$8,121	
b. Disposal		
Disposal Fee per ton	$370	
Disposal Cost ($)	$118,438	
Total Cost - Licensed Site	$126,559	
Total Cost Transportation & Disposal	**$126,559**	
Total Cost - Buried Trunkline Removal & Disposal	**$218,127**	
TOTAL WELLFIELD EQUIPMENT REMOVAL & DISPOSAL COST	**$335,643**	

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Worksheet 6, No. I
TOPSOIL REPLACEMENT & REVEGETATION

Cost Item	Mining Unit Nichols #1	Notes
I Process Plant and Office Building		
A. Topsoil Handling & Grading		
Affected Area (Acres)	5.2	Plant site is 475' by 475'
Average Affected Thickness (Ins)	12	
Topsoil Volume (Yds^3)	8,356	
Unit Cost ($/cy)	$5	Price from Dragstrip Soil Cover Project MT
Sub Total - Topsoil	$44,197	
B. Radiation Survey & Soil Analysis		
Unit Cost ($/Ac)	$635	
Sub Total - Survey & Analysis	$3,287	
C. Revegation		
Fertilizer ($/Ac)	$245.41	Price from Dragstrip Soil Cover Project MT
Seeding Prep & Seeding ($/Ac)	$240.12	Price from Dragstrip Soil Cover Project MT
Mulching & Crimping ($/Ac)	$105.78	Price from Dragstrip Soil Cover Project MT
Sub Total Cost/Acre	$591.31	
Sub Total Revegation	$3,063	
TOTAL PLANT AND OFFICE BUILDING TOPSOIL REPLACEMENT & REVEG COST	**$50,548**	

Surety Estimate
First Year of Operation
Nichols Ranch ISR Project
Uranerz Energy Corporation

Worksheet 6, Nos. II & III
TOPSOIL REPLACEMENT & REVEGETATION

Cost Item	Mining Unit Nichols #1	Notes
II Wellfields		
A. Topsoil Handling & Grading		
Affected Area (Acres)	22	Equals trench length times 12 feet wide
Average Affected Thickness (Inch)	12	
Topsoil Volume (Yds^3)	35,217	
Unit Cost - Haul/Place/Grading ($/cy)	$5.29	Price from Dragstrip Soil Cover Project MT
Sub Total - Topsoil	$186,261	
B. Radiation Survey & Soil Analysis		
Unit Cost ($/Ac)	$635	
Sub Total - Survey & Analysis	$13,854	
C. Spill Cleanup		
Affected Area (Acres)	0	
Affected Area (Ft^2)	0	
Affected Area Thickness (Ft)	0.25	
Affected Volume (Ft^3)	0	
Quantity per Truckload (Ft^3)	540	
Quantity to be Shipped (Loads)	0	
Distance (Miles)	160	
Transportation Cost (Ton/Mile) ($)	$0.16	
Transportation Cost ($)	$0	
Handling Cost ($/Load)	$212	
Handling Cost ($)	$0	
Disposal Fee ($/Ton)	$370	
Disposal Cost ($)	$0	
Sub Total - Spill Cleanup	$0	
D. Revegation		
Fertilizer ($/Ac)	$245.41	Price from Dragstrip Soil Cover Project MT
Seeding Prep & Seeding ($/Ac)	$240.12	Price from Dragstrip Soil Cover Project MT
Mulching & Crimping ($/Ac)	$105.78	Price from Dragstrip Soil Cover Project MT
Sub Total Cost/Acre	$591.31	
Sub Total Revegation	$12,907	
Sub Total - Wellfields	$213,023	
TOTAL WELLFIELDS COST	**$213,023**	
III Roads		
A. Topsoil Handling & Grading		
Affected Area (Acres)	5.17	3750 feet by 60 feet wide
Average Affected Thickness (Ins)	12	
Topsoil Volume (Yds^3)	8,333	
Unit Cost - Haul/Place/Grading ($/cy)	$5.29	Price from Dragstrip Soil Cover Project MT
Sub Total - Topsoil	$44,075	
B. Radiation Survey & Soil Analysis		
Unit Cost ($/Ac)	$635	
Sub Total - Survey & Analysis	$3,278	
C. Revegation		
Fertilizer ($/Ac)	$245	Price from Dragstrip Soil Cover Project MT
Seeding Prep & Seeding ($/Ac)	$240	Price from Dragstrip Soil Cover Project MT
Mulching & Crimping ($/Ac)	$106	Price from Dragstrip Soil Cover Project MT
Sub Total Cost/Acre	$591	
Sub Total Revegation	$3,054	
Sub Total - Roads	$50,408	
TOTAL ROADS COST	**$50,407.59**	

Surety Estimate
First Year of Operation
Nichols Ranch ISR Project
Uranerz Energy Corporation

Worksheet 6, Nos IV & V
TOPSOIL REPLACEMENT & REVEGETATION

Cost Item	Mining Unit Nichols #1	Notes
IV Other		
A. Topsoil Handling & Grading		
Affected Area (Acres)	0	
Average Affected Thickness (Ins)	3	
Topsoil Volume (Yds^3)	0	
Unit Cost - Haul/Place/Grading ($/Ac)	$5.29	Price from Dragstrip Soil Cover Project MT
Sub Total - Topsoil	$0	
B. Radiation Survey & Soil Analysis		
Unit Cost ($/Ac)	$635	
Sub Total - Survey & Analysis	$0	
C. Revegation		
Fertilizer ($/Ac)	$245.41	Price from Dragstrip Soil Cover Project MT
Seeding Prep & Seeding ($/Ac)	$240.12	Price from Dragstrip Soil Cover Project MT
Mulching & Crimping ($/Ac)	$105.78	Price from Dragstrip Soil Cover Project MT
Sub Total Cost/Acre	$591.31	
Sub Total Revegation	$0	
Sub Total - Other	$0	
TOTAL OTHER COST	**$0**	
V Remedial Action		
A. Topsoil Handling & Grading		
Affected Area (Acres)	0	Assume no excursions/spills
Average Affected Thickness (Ins)	3	
Topsoil Volume (Yds^3)	0	
Unit Cost - Haul/Place/Grading ($/cy)	$5.29	Price from Dragstrip Soil Cover Project MT
Sub Total - Topsoil	$0	
B. Radiation Survey & Soil Analysis		
Unit Cost ($/Ac)	$635	
Sub Total - Survey & Analysis	$0	
C. Revegation		
Fertilizer ($/Ac)	$245.41	Price from Dragstrip Soil Cover Project MT
Seeding Prep & Seeding ($/Ac)	$240.12	Price from Dragstrip Soil Cover Project MT
Mulching & Crimping ($/Ac)	$105.78	Price from Dragstrip Soil Cover Project MT
Sub Total Cost/Acre	$591.31	
Sub Total Revegation	$0	
TOTAL REMEDIAL ACTION	**$0**	
TOTAL TOPSOIL REPLACEMENT & REVEGETATION COST (Total of 7I through 7V)	**$313,978**	

Surety Estimate
First Year of Operation
Nichols Ranch ISR Project
Uranerz Energy Corporation

Worksheet 7, Nos I - VII
MISCELLANEOUS RECLAMATION

	Cost Item	Mining Unit Nichols #1	Notes
I	**Fence Removal & Disposal**		
	Quantity (Ft)	8,558	
	Cost of Removal/Disposal ($/Ft)	$0.39	Demolition Unit Cost per WDEQ Guideline No.12, App. H
	Cost of Removal/Disposal ($)	$3,335	
II	**Powerline Removal & Disposal**		
	Quantity (Ft)	160,460	Power to Wells, header houses. Other power already in place by CBM companies
	Cost of Removal/Disposal ($/Ft)	$0	Lines buried in pipe trenches. Excavation costs covered on Sheets 6I and 6III. Assume salvage of wire at no cost.
	Cost of Removal/Disposal ($)	$0	
III	**Powerpole Removal & Disposal**		
	Quantity	0	Overhead powerpoles and lines will remain in place for future gas production
	Cost of Removal/Disposal ($/Each)	0	
	Cost of Removal/Disposal ($)	$0.00	
IV	**Transformer Removal & Disposal**		
	Quantity	0	
	Cost of Removal/Disposal ($/Each)	0	Tri-County Electric will remove at no cost, WDEQ Guideline No.12, App. H
	Cost of Removal/Disposal ($)	0	
V	**Culvert Removal & Disposal**		
	Quantity (Ft)	0	None
	Cost of Removal/Disposal ($/Ft)	$5.33	($101.21/20') WDEQ Guideline No.12, App. J
	Cost of Removal/Disposal ($)	$0.00	
VI	**Guardrail Removal**		
	Quantity (Ft)	0	None
	Cost of Removal/Disposal ($/Ft)	$6.88	
	Cost of Removal/Disposal ($)	$0	
VII	**Low Water Stream Crossing**		
	Quantity	0	None
	Cost of Removal/Disposal ($/Each)	$8,462	
	Cost of Removal/Disposal ($)	$0	
	TOTAL MISCELLANEOUS COST	**$3,335**	

ADDENDUM 6C1:
RENO CREEK ISL HYDROLOGY

October 2008

RENO CREEK ISL HYDROLOGY

FOR:

PATHFINDER MINES CORPORATION
BETHESDA, MARYLAND

BY:

HYDRO-ENGINEERING

OCTOBER, 1991

GEORGE L. HOFFMAN, P.E.
HYDROLOGIST

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EXHIBITS

IV.1 INTRODUCTION

This report presents an evaluation of the hydrologic conditions at the Reno Creek ISL property. Three main reports present all of the ground-water information that has been collected on this property. The first of these reports, entitled "Hydrologic Evaluation of the Reno Creek Property for Insitu Uranium Recovery", was developed in 1979 by Insitu. This report presents the information on the wells in Pattern I and the detail multi-well pump test that was conducted on the Pattern I wells. The mean transmissivity and storage coefficient presented in the Insitu report are 1,852 gal/day/foot and 4.6E-4, respectively, for the aquifer at the Pattern I site. The second report was an in-house report by Union Pacific Resources-Minerals (UPM) (1981) and is entitled "Hydrologic Analysis of the Reno Creek Pattern II Property". This report presents the ground-water data on the Pattern II wells and the detail pump and injection tests of these wells. The mean transmissivity of 1,757 gal/day/foot and storage coefficient of 8.8E-3 were presented in the UPM (1981) report for the Pattern II area. The third report, developed by UPM in November, 1982, entitled "Hydrogeologic Integrity Evaluation of the Reno Creek Project Area", presents the information on the regional wells and the corresponding pump tests. A mean hydraulic conductivity of 2.4 ft/day and mean storage coefficient of 2.9E-4 were presented in UPM (1982). Information on regional wells RI 1 through 14 is also presented in the Insitu report with numerous single-well pump tests on these wells. The integrity test report

also includes the use of packer tests on 33 exploration holes to define the continuity of the sands across the A, B, C, E and G Mudstones.

This evaluation presents the geologic setting, well completion, aquifer properties and water-level data for the ground-water conditions at Reno Creek. It also presents our evaluation of the likely head conditions in the aquifer between injection and recovery wells during operation and expected maximum injection and recovery rates from partially penetrating wells.

IV.2 GEOLOGIC SETTING

The geologic setting at the Reno Creek ISL project has been named by numbering the ore sand sequences from top to bottom of the mineralized zone with numbers 1 through 5. The No. 1 Sand exists below the Felix Coal and underlying C Mudstone, which is normally adjacent to the Felix Coal. Figure IV-1 presents a generalized geologic setting of the sands and mudstone sequences at the north end of the Reno Creek project. Overlying sand typically exists above the A Mudstone, which is located above the Felix Coal and has been named the Upper Sand. This Upper Sand is generally a lower permeability sand and, in some places, does not exist over the northern Reno Creek area. The mineralized sands, 1 through 4, can be separated by different mudstones, D, E and F, and the sand exists in some locations as one complete sand sequence in excess of 100 feet. The G Mudstone exists below the No. 4 Sand and above the No. 5 Sand sequences. The No. 5 Sands are typically more shalely and, therefore, in general, do not have the permeabilities of the above mineralized zone. The No. 1 through 4 sands, in general, have been considered as one aquifer in the definition of ground-water hydrology at this site. This is probably a correct approach to the definition of this ground-water system, except for some localized areas where a mudstone, for example the E Mudstone, exists and mineralization is only below this mudstone in the 3 and 4 Sands. The definition of the No. 3 and 4 sands as a separate aquifer in that area would be worth considering.

IV.3 WELL COMPLETIONS

Numerous wells have been completed at the Reno Creek ISL area to define the ground-water conditions. A series of wells initially named with the prefix of RRBM were completed. This series of wells went from 1 through 14. These well names have been changed in the Integrity report to the RI series with the same following number. Well RI-8 has been destroyed. Exhibit IV-1 shows the location of the RI wells. This drawing also shows the locations of Patterns I and II. Figure IV-2 shows the locations of the wells within Patterns I and II. All of these wells, in Patterns I and II, have been abandoned. A supply well was referred to in one of the reports to exist at the site. No information was found documenting the completion information on this supply well, but is reported to be near the R & D ISL plant. Table IV-1 presents the basic well data for the existing wells at Reno Creek, while Tables IV-2 and IV-3 present the completion information of the abandoned wells for Patterns I and II, respectively.

The initial wells RI-1 through 14 were completed with five-inch casings and sand packed with a seal above the perforations. A few of these wells, RI-1, RI-2 and RI-5, extend through the G Mudstone and may connect the underlying No. 5 sand. The two-inch diameter wells were also completed similar to the completion of the initial wells. The later five-inch diameter wells consist of four-inch telescope screen, installed in an open interval below cemented annulus casing above the screen.

IV.4 AQUIFER PROPERTIES

Aquifer properties have been re-analyzed for the Reno Creek ISL pump tests. Appendix A presents Hydro-Engineering's re-analysis of the pump test data. Also, two injections tests, presented in UPM (1981), that were not previously analyzed are presented in this section. Table IV-4 presents the summary of aquifer properties based on Hydro-Engineering's analysis. This table presents the well number, aquifer thickness, the transmissivity from the straight-line and recovery test methods, hydraulic conductivity, the anisotropic ratio (Kv/Kh), the storage coefficient, the ratio of storage coefficient to specific yield and the distance from the pumping well for observation wells. The transmissivities shown on Table IV-4 vary from 542 to 6,490 gal/day/foot and hydraulic conductivities (permeabilities) vary from 0.58 (0.21) to 5.3 ft/day (1.9 Darcies). An average transmissivity is 1,500 gal/day/foot and a typical hydraulic conductivity for this material is 2.0 ft/day or 0.7 Darcies.

None of the multi-well tests conducted by UPM were conducted long enough to adequately define the specific yield value. This is the storage value for yield from the unconfined portion of the aquifer. This unconfined storage value will be important in the northeastern portion of the Reno Creek property.

IV.5 WATER LEVELS

Table IV-1 presents basic well data and the 1982 UPM water levels and five water-level measurements made by Donna Wichers on October 22, 1991. This table presents the change in water level from the 1982 water-level measurements to the 1991 values. These water levels have risen from 2.94 to 6.14 feet. In general, the rise has been greatest in the confined portion of the aquifer to the west, with a typical rise of six feet, and slightly less, at three feet, in the unconfined portion on the east side of the property. These rises are likely due to a natural increase in recharge to this aquifer because they are larger farther away from the pilot test sites.

The water-level elevations presented on Exhibit IV-1 were developed by UPM. This piezometric map shows that the ground water flows from the southwest to the northeast. The aquifer is confined west or north of the highway and is slightly confined in some areas of mining unit 2.1-2.7 (see Figure IV-3).

IV.6 HYDROLOGIC PREDICTIONS FOR OPERATIONS

A well field of 33 recovery and 27 injection wells in five-spot patterns, with spacing of 100 feet between injectors, was used to predict the maximum recovery and injection rates for the Reno Creek aquifer conditions. A profile of heads between the injection and recovery wells was also developed during this analysis.

The partially penetrating equation presented in program PT4 of Walton's 1987 book, "Ground Water Pumping Tests", was used to simulate the drawdowns at the injection and recovery wells in between these two wells. A horizontal hydraulic conductivity of 15 gal/day/foot (2 ft/day, 0.7 Darcy), vertical hydraulic conductivity of 3 gal/day/foot or a Kv/Kh of 0.2, and a storage coefficient of 0.0005 were used in the simulation of these drawdowns. These are the average aquifer properties obtained from Hydro-Engineering's re-analysis of the pump tests. The average partial completion is expected to be 13.4 feet from 53.3 to 67.7 feet below the top of a 120-foot thick sand. This completion interval assumes that the mineralization is in the middle of the ore sand. The time of simulation was 100 days. The maximum recovery rate for these conditions, and a maximum drawdown of 50 feet, was 13.0 gpm. The corresponding injection rate was 15.8 gpm, which resulted in a head build-up of 72.6 feet at the injector for a 100 percent efficient well or 135 feet for a 50% efficient well. The typical maximum injection head in this area of the aquifer will be approximately 500 feet (150 PSI at well head plus 150 feet below land surface). This indicates that the maximum injection rate for this condition

is 54 gpm, which shows that this system will be controlled by the recovery rates.

The maximum recovery rates on the western half of the property will be significantly better, with an average maximum drawdown of 120 to 170 feet. This will allow the maximum recovery rates to be 31 to 34 gpm, while the maximum injection rate should be similar, at 54 gpm. Table IV-5 presents an estimate of recovery and injection rates for the different mine units. Figure IV-3 shows the locations of the different mining units.

Figure IV-4 presents the profile of heads between the injection and recovery wells initially discussed in this section, except for a completion of eight feet. The predicted heads between the injection and recovery wells should be similar to those in this figure for a completion interval of 13.4 feet. This figure shows that near the injection and recovery wells, heads are expected to be significantly different, but the majority of the area between injection and recovery wells will have 50 feet of head above the mineralization. Table IV-6 presents the aquifer confinements and head above the ore in each of the monitoring wells shown in the table. The confinement and head above the ore in this table were developed from geophysical logs of wells presented in Table IV-6 and, therefore, may not represent the average conditions of the ore body in some of the areas.

IV.7 CONCLUSIONS AND RECOMMENDATIONS

The mineralization in the north Reno Creek property is mainly in the No. 1 through No. 4 sands. UPM has completed 59 wells to define the aquifer conditions on the entire Reno Creek property with 34 of these wells presently existing. The mineralized sand throughout the property contains a good hydraulic conductivity (permeability) for insitu mining, with an average value of 2.0 ft/day (0.7 Darcies). The distance of the water level above the mineralized portion of the aquifer is important and varies considerably from zero to greater than 150 feet. Maximum recovery rates will restrict the well field flow rates. A ratio of 1.2 recovery wells were used to each injection well in simulations of potential well fields in each mining unit. A recovery rate of 13 gpm is expected from the mineralized No. 3 sand in mining units 1.1-1.7 and 2.1-2.7, while the recovery rates for the remainder were from 26 to 34 gpm. Maximum injection rates for these simulations varied from 51 to 71 gpm, showing that a larger ratio is desirable.

A multi-well pump test in the unconfined portion of the aquifer needs to be conducted for a minimum of three days to define this property adequately. Also, none of the multi-well pump tests included aquitard wells for the Neuman-Witherspoon aquitard analysis to define the vertical permeability of the aquitards. These types of tests will need to be conducted prior to any permitting of this property.

IV.8 REFERENCES

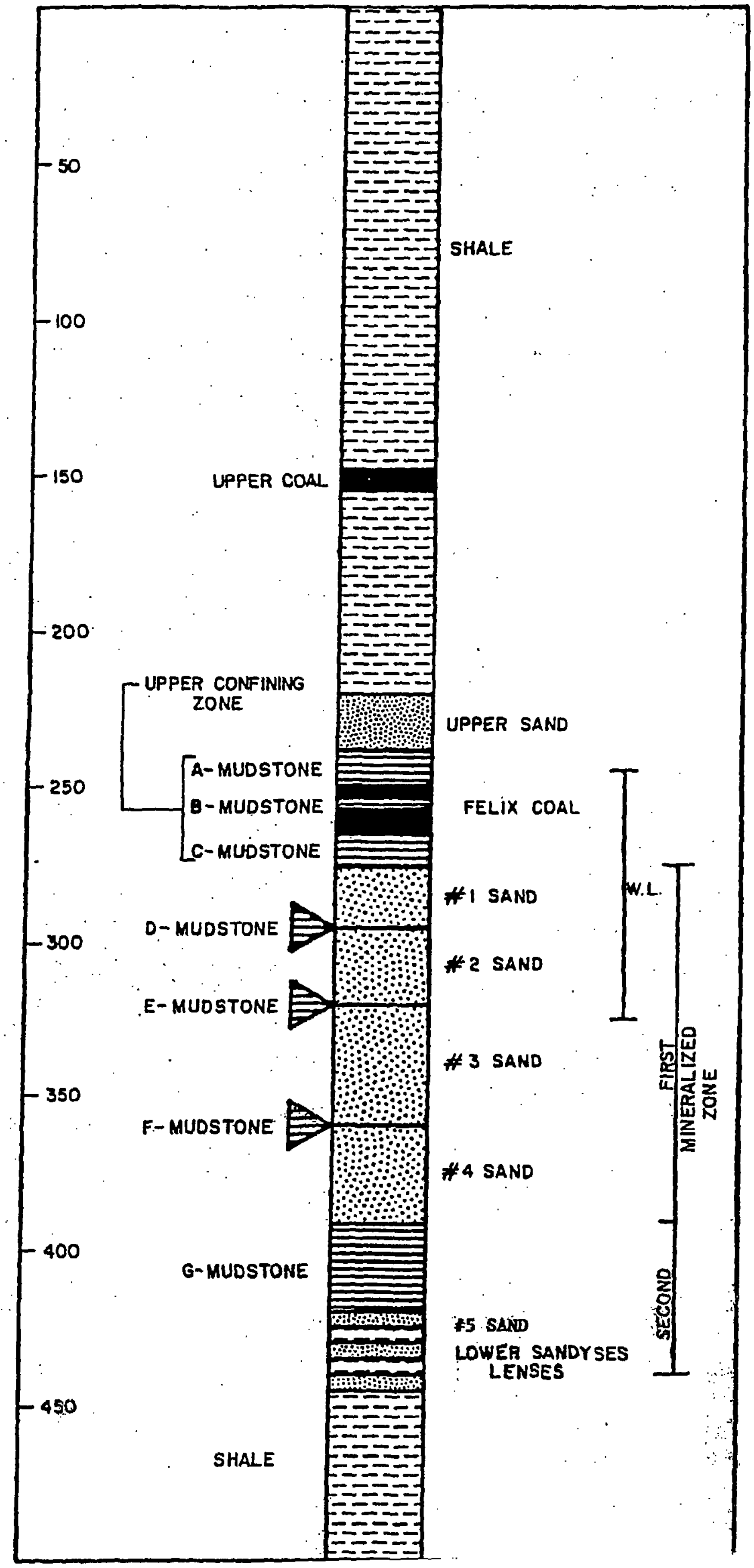
Insitu Consulting, 1979, Hydrologic Evaluation of the Reno Creek Property for In-Situ Uranium Recovery, Consulting Report for Rocky Mountain Energy Co.

Union Pacific Resources-Minerals, 1981, Hydrologic Analysis of the Reno Creek - Pattern 2 Property for Insitu Uranium Recovery.

Union Pacific Resources-Minerals, 1982, Hydrogeologic Integrity Evaluation of the Reno Creek Project Area.

FIGURE IV-1.

GENERALIZED HYDROSTRATIGRAPHIC SECTION OF THE NORTH MINE AREA



027-02-G-080

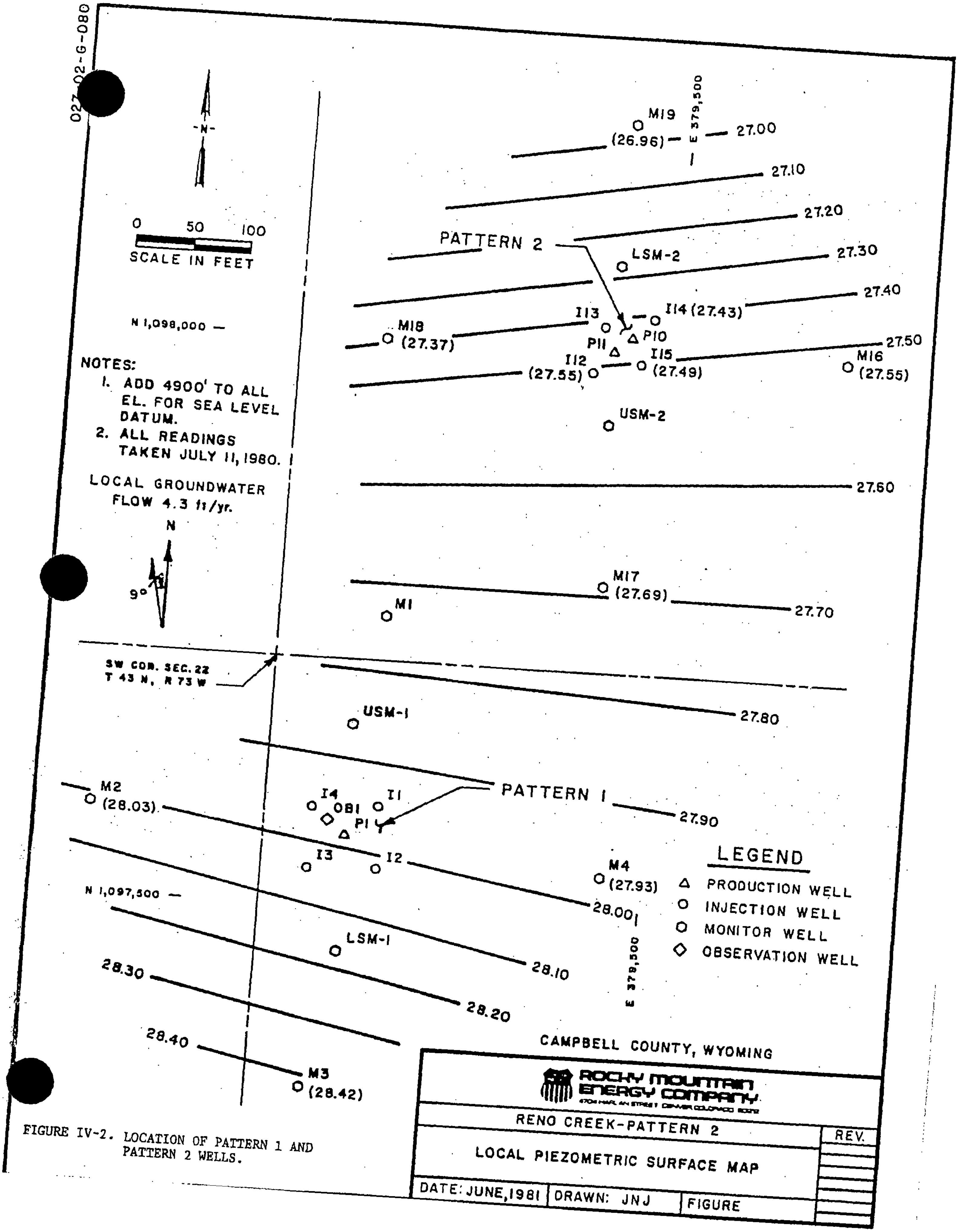


FIGURE IV-2. LOCATION OF PATTERN 1 AND PATTERN 2 WELLS.

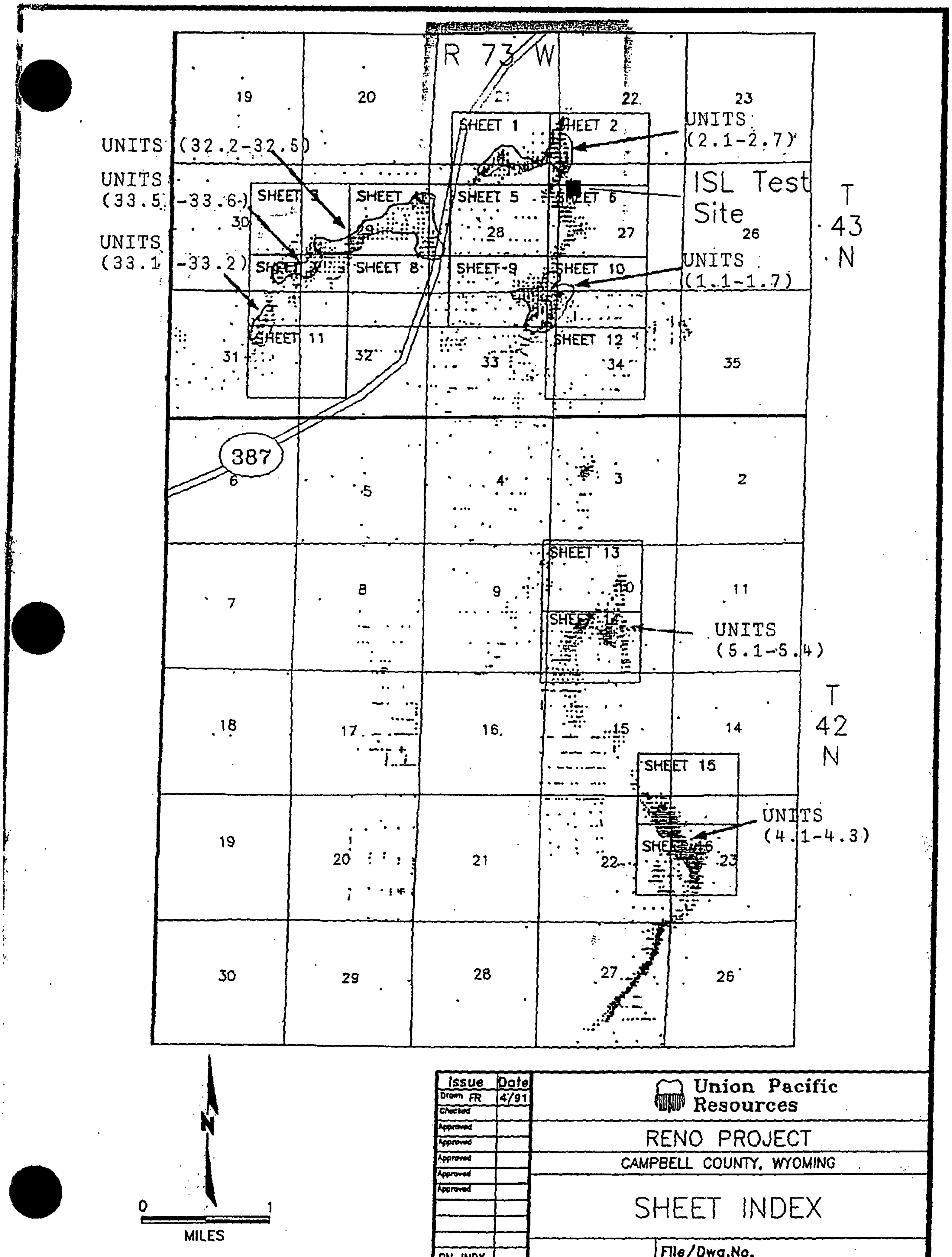


FIGURE IV-3. LOCATION OF MINING UNITS.

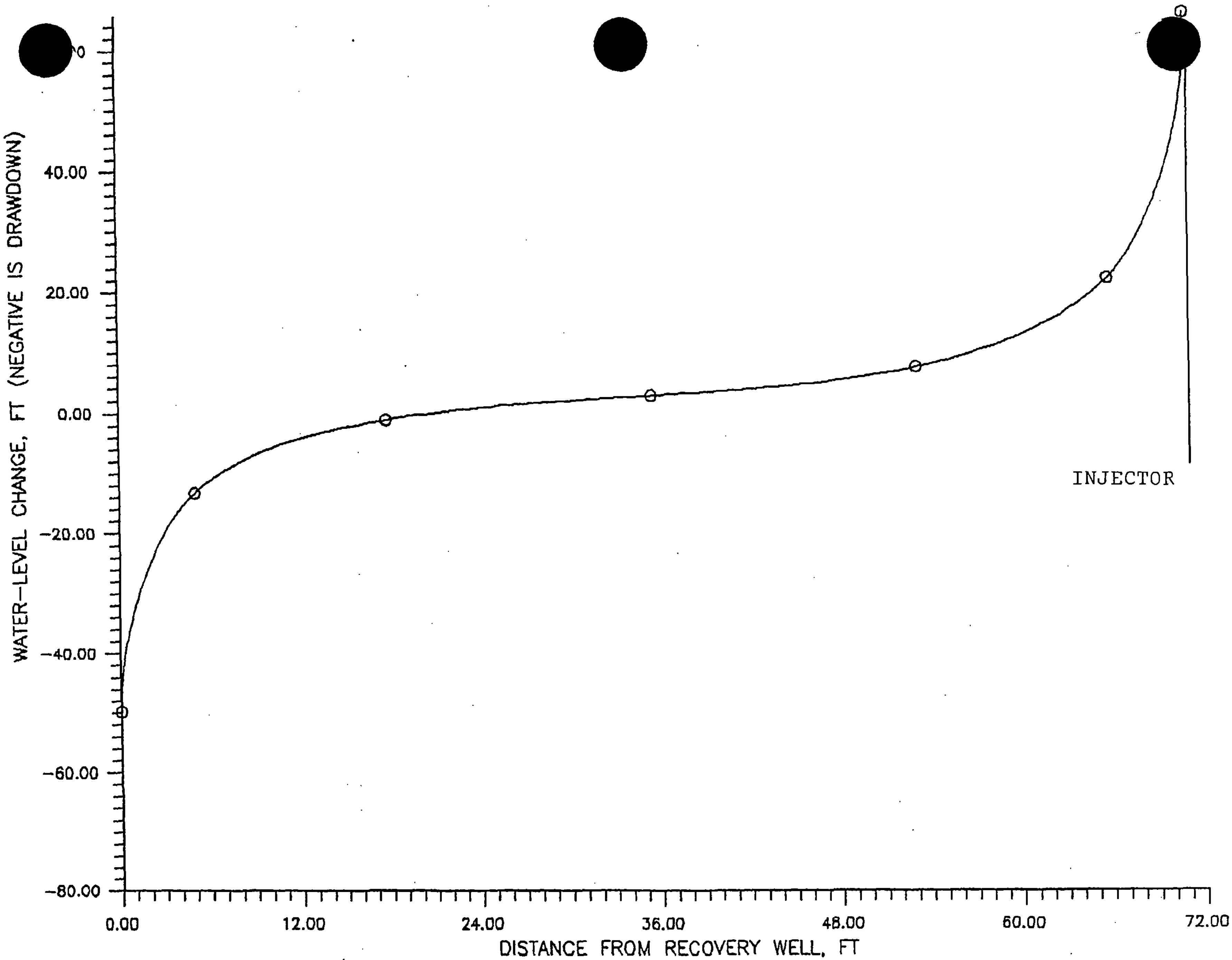


FIGURE IV–4. PROFILE OF WATER–LEVEL CHANGE BETWEEN RECOVERY & INJECTION WELLS.

TA[illegible]-1.

BASIC WELL DATA THAT EXISTS AT RENO CREEK ISL.

Completion Sands	Well Number	Ground Elevation (ft.)	Depth Drilled (ft.)	Well Diameter (In.)	Top of Sand Elevation (ft.)	Bottom of Sand Elevation (ft.)	Sand Thickness (ft.)	Screened Interval (ft.)	Depth to Water (ft-GSD)	Static Water Level Elevation (ft.)	Depth to Water 10/22/91 (ft-MP)	Change in Water Level (ft.)
1-4	RI-1	5,076.30	320.0	5	4,931	4,761	170	160-320	108.25	4,968.05		
1-4	RI-2	5,115.60	380.0	5	4,893	4,746	147	220-380	139.95	4,975.65		
1-4	RI-3	5,165.30	400.0	5	4,945	4,772	173	220-400	216.30	4,949.00		
1-4	RI-4	5,126.80	340.0	5	4,914	4,790	124	220-340	205.59	4,921.21		
1-5	RI-5	5,217.70	410.0	5	4,983	4,837	146	270-410	283.15	4,934.55	281.40	+2.94
1-4	RI-6	5,267.60	400.0	5	4,977	4,873	104	280-400	323.93	4,943.67		
1-3	RI-7	5,212.70	330.0	5	4,986	4,874	112	190-330	258.75	4,953.95		
3-4	RI-9	5,108.20	290.0	5	5,046	4,819	226	150-290	138.11	4,970.09		
3-4	RI-10	5,152.50	270.0	5	5,077	4,880	197	190-270	179.47	4,973.03		
3-4	RI-11	5,073.70	185.0	5	5,046	4,898	148	125-185	88.06	4,985.64		
1-4	RI-12	5,325.20	460.0	5	5,013	4,871	142	310-460	341.50	4,983.70		
1-2	RI-13	5,214.50	306.0	5	4,996	4,897	99	206-306	246.80	4,967.70		
1-2	RI-14	5,144.62	260.0	5	4,992	4,899	93	152-245	180.88	4,965.42		
U	RI-15U	5,268.35	245.0	5	5,056	5,027	29	195-245	188.28	5,080.07		
2-4	RI-16	5,270.07	405.0	5	4,998	4,876	122	315-395	323.58	4,946.49		
5	RI-17L	5,268.64	495.0	5	4,862	4,773	89	407-495	325.60	4,943.04		
2-4	RI-18	5,238.79	370.0	5	5,004	4,877	127	280-363	296.56	4,942.23		
5	RI-19L	5,152.18	432.0	5	4,840	4,815	25	285-383	207.01	4,945.17		
5	RI-20L	5,106.36	382.0	5	4,806	4,724	82	286-382	142.72	4,963.64		
U	RI-21U	5,176.40	195.0	2	5,054	4,981	73	137-195	116.36	5,060.04		
3-5	RI-22	5,215.72	380.0	2	4,981	4,835	146	300-380	281.39	4,934.33	279.71	+3.17
U	RI-23U	5,169.74	208.0	2	5,039	4,971	68	129-208	142.19	5,027.55		
U	RI-24U	5,125.42	146.0	5	5,011	4,997	14	120-140	91.48	5,033.94		
U	RI-25U	5,076.03	116.0	2	5,047	4,693	50	66-116	32.35	5,043.68		
3-5	RI-27L	5,078.00	355.0	2	4,752	4,723	29	235-355	110.70	4,967.30		
1-4	RI-28	5,108.81	370.0	5	4,908	4,743	165	213-370	146.42	4,962.39	141.70	+6.14
U	RI-30U	5,106.88	160.0	5	5,030	4,948	82	79-158	76.84	5,030.04		
U	RI-32U	5,223.30	252.0	2	5,043	4,974	69	182-250	177.40	5,045.90		
U	RI-33U	5,126.14	133.0	2	5,093	4,997	96.5	59-133	40.11	5,086.03		
1-4	RI-34	5,101.20	360.0	5	4,910	4,744	166	183-360	137.70	4,963.50	132.54	+5.69
5	RI-35L	5,098.74	400.0	5	4,714	4,698	16	357-397	143.05	4,955.69	138.00	+5.75
2	RI-36	5,152.24	175.0	5	5,077	4,977	100	119-175	153.63	4,998.61		
3-4	RI-37	5,151.39	275.0	5	5,077	4,881	196	188-260	178.28	4,973.11		
U	RI-38U	5,272.76	228.0	5	5,111	5,068	43	51-207	197.14	5,075.62		
5	RI-39L	5,074.25	260.0	5	4,865	4,826	39.5	207-249	104.38	4,969.87		
1-2	RI-40	5,073.55	975.0	5	---	---	---	41-97.5	86.06	4,986.49		
3-4	RI-41	5,074.44	179.0	5	4,950	---	---	138-179	94.90	4,979.65		

TABLE IV-2. BASIC WELL DATA FOR PATTERN #1 WELLS (ABANDONED).

WELL NO	COORDINATES (ft.) N	COORDINATES (ft.) E	SAND DEPTH (ft.)	AQUIFER	PERFORATED OR SCREEN INTERVAL	DRIFT (ft.) N	DRIFT (ft.) E	CASING TOTAL DEPTH (ft.)	ELEVATION (ft.) TOP OF CASING	ELEVATION (ft.) PIEZOMETRIC SURFACE (June 3, 78)
P1	1,097,561.2	379,243.4	286-401	PRODUCTION	319-339 355-366	-1.5	+0.1	413	5,213.37	4931.15
I1	589.1	271.3	283.5-401.5	PRODUCTION	353.5-369.5 323.5-332.5	-1.7	+2.0	414	5,213,25	4931.09
I2	533.6	272.5	283.5-401.5	PRODUCTION	320.5-338.5 361.5-371.5	-3.3	-0.7	413	5,214.94	4931.22
I3	532.3	215.7	283.5-401.5	PRODUCTION	320.5-329.5 333.5-341.5 356.5-364.5	-0.1	-0.7	418	5,213.63	4931.25
I4	587.0	214.6	283-400	PRODUCTION	317-323 329-337 349-355	+0.3	+0.8	414	5,213.58	4931.16
OB1	574.4	229.7	285.5-400.5	PRODUCTION	278-395	-2.1	+4.2	395	5,213.39	4931.15
M1	758.0	264.4	268-388	PRODUCTION	266-386	+1.3	-1.5	386	5,202.21	4930.80
M2	580.9	023.1	256.5-389.5	PRODUCTION	249-405	-1.4	+1.5	405	5,203.93	4931.28
M3	339.8	221.5	277-398	PRODUCTION	270-407	-1.0	-0.8	407	5,210.59	4931.71
M4	537.1	465.1	273-393	PRODUCTION	265-383	-2.5	+3.9	383	5,208.22	4931.82(?)
USM-1	661.2	243.5	182.5-190.5	UPPER SAND	176-215	-0.7	+0.8	215	5,210.44	5027.11
LSM-1	460.2	243.8	438-459	LOWER SAND	415-461 435-455	-1.9	+0.8	461	5,214.94	4918.72

TABLE IV-3. BASIC WELL DATA FOR PATTERN #2 WELLS (ABANDONED).

RENO CREEK

Well Name and Number[1]	Coordinates (ft.) N(Y)	Coordinates (ft.) E(X)	Top of Casing Elevation (ft.)	Ground Elevation (ft.)	Casing TD (ft.)
Production Wells					
P10	1,098,013.3	379,461.6	5,182.41	5,181.03	400
P11	1,098,000.0	379,447.1	5,182.17	5,181.22	400
Injection Wells					
I-12	1,097,982.9	379,428.8	5,183.78	5,181.43	400
I-13	1,098,022.7	379,437.6	5,182.26	5,180.31	400
I-14	1,098,030.3	379,479.2	5,183.89	5,182.21	400
I-15	1,097,989.5	379,471.2	5,183.74	5,182.24	400
Monitor Wells					
M16	1,097,998.2	379,651.3	5,192.09	5,190.62	400
M17	1,097,796.8	379,448.6	5,192.48	5,191.10	400
M18	1,097,998.7	379,248.5	5,188.12	5,186.77	400
M19	1,098,199.6	379,450.0	5,186.25	5,184.85	400
USM-2	1,097,936.21	379,446.15	5,185.17	5,183.30	190
LSM-2	1,098,077.14	379,447.75	5,183.03	5,181.00	400

[1] Five-inch well

TABLE IV-3. BASIC WELL DATA FOR PATTE[illegible] WELLS (ABANDONED) (continued).

RENO CREEK

(Continued)

Well Name and Number	(Perforated Interval) # Perforations (ft.)	Under-Reamed Interval (ft.)	Total Thickness of Reamed/Perforated Interval (ft.)	Top Sand[2]	Bottom Sand[2]	Depth to Water Level (ft.)[3]	Piezometric Surface Elevation (ft.)[4]
Production Wells							
P10		(285-310) (330-335)	25 5	244	370	255.20	4,927.21
P11		(285-310)	25	244	370	255.00	4,927.17
Injection Wells							
I-12		(290-303)	13	244	370	256.74	4,927.04
I-13		(288-301)	13	244	370	255.18	4,927.08
I-14		(293-304) (332-338)	11 6	245	373	256.80	4,927.09
I-15		(292-305)	13	245	370	256.66	4,927.08
Monitor Wells							
M16	(262-374) 336		112	259	375	264.80	4,927.29
M17	(269-377) 324		108	266	378	265.21	4,927.27
M18	(258-378) 360		120	252	379	261.10	4,927.02
M19	(257-353) 288		96	258	353	259.16	4,927.09
USM-2		(150-190)	40	151	190	152.75	5,032.42
LSM-2		(400-440)	40	410	440	260.40	4,922.63

2 From ground elevation; average aquifer thickness = 121 ft.

3 From top of casing

4 Measured on May 27, 1980

TABLE IV-4. SUMMARY OF RE-ANALYZED AQUIFER PROPERTIES.

WELL NO.	AQUIFER THICKNESS (FT)	TRANSMISSIVITY STRAIGHT LINE EARLY (GPD/FT)	TRANSMISSIVITY STRAIGHT LINE LATE (GPD/FT)	TRANSMISSIVITY RECOVERY (GPD/FT)	HYDRAULIC CONDUCTIVITY (FT/DAY)	HYDRAULIC CONDUCTIVITY (DARCY)	Kv/Kh	STORAGE COEFFICIENT (DIMENSIONLESS)	S/Sy	DISTANCE FROM PUMPING WELL (FT)
					OB-1 TEST					
OB-1	120	920	---	---	1.0	0.37	--	---	--	--
P-1		1030	---	---	1.1	0.42	0.2	1.0E-3	0.01	22.5
I-1		1680	---	---	1.9	0.68	0.3	4.7E-4	0.01	46.1
M-4		1680	---	---	1.9	0.68	0.3	2.4E-4	0.01	23.9
					P-10 TEST					
P-10	115	1900	---	---	2.2	0.81	--	---	--	--
I-12		1810	---	---	2.1	0.77	0.1	6.9E-4	0.01	44.7
M-16		1770	---	---	2.1	0.75	0.3	6.0E-4	0.01	190.3
					I-12 INJECTION TEST					
I-12	115	1310	---	---	1.5	0.56	--	---	--	--
P-10		2020	---	---	2.3	0.86	0.3	5.8E-4	0.01	44.7
I-15		1810	---	---	2.1	0.77	0.3	8.4E-4	0.01	42.9
					I-15 INJECTION TEST					
I-15	115	1510	---	---	1.8	0.64	--	---	--	--
P-10		1190	---	---	1.4	0.50	0.3	1.1E-3	0.01	25.7
I-12		1840	---	---	2.1	0.78	0.3	4.5E-4	0.01	42.9
					RI-5 TEST					
RI-5	92	564	---	---	0.82	0.30	--	---	--	--
RI-22		1520	1530	---	2.2	0.81	0.075	2.6E-4	0.1	48.0
					RI-28 TEST (2ND)					
RI-28	163	1550	---	1550	1.3	0.46	--	---	--	--
RI-34		1620	---	1540	1.3	0.48	--	1.3E-4	--	77.0

TABLE IV-4. SUMMARY OF RE-ANALYZED AQUIFER PROPERTIES (continued).

WELL NO.	AQUIFER THICKNESS (FT)	TRANSMISSIVITY STRAIGHT LINE EARLY (GPD/FT)	TRANSMISSIVITY STRAIGHT LINE LATE (GPD/FT)	TRANSMISSIVITY RECOVERY (GPD/FT)	HYDRAULIC CONDUCTIVITY (FT/DAY)	HYDRAULIC CONDUCTIVITY (DARCY)	Kv/Kh	STORAGE COEFFICIENT (DIMENSIONLESS)	S/Sy	DISTANCE FROM PUMPING WELL (FT)
					SINGLE-WELL TESTS					
RI-1 (1)	168	6490	---	6080	5.3	1.9	--	---	--	---
RI-1 (2)	168	3380	3970	6190	3.2	1.2	--	---	--	---
RI-2	117	1410	---	1170	1.6	0.59	--	---	--	---
RI-3 (1)	146	3370	---	3430	3.1	1.1	--	---	--	---
RI-3 (2)	146	3500	---	4400	3.2	1.2	--	---	--	---
RI-4	124	542	---	561	0.58	0.21	--	---	--	---
RI-5	92	1300	---	1520	1.9	0.69	--	---	--	---
RI-6	62	785	---	826	1.7	0.62	--	---	--	---
RI-7	59	1350	---	925	3.1	1.1	--	---	--	---
RI-8		950	---	1070	--	--	--	---	--	---
RI-9 (1)	121	4910	---	2560	2.8	1.0	--	---	--	---
RI-9 (2)		2920	---	3010	3.2	1.2	--	---	--	---
RI-10	80	1990	---	713	3.3	1.2	--	---	--	---
RI-28	163	1320	---	1310	1.1	0.39	--	---	--	---

TABLE IV-5. PREDICTED INJECTION AND RECOVERY RATES.

UNIT	DEPTH TO WATER LEVEL (FT-LSD)	HEAD ABOVE MINERALIZED (FT)	MAXIMUM RECOVERY (GPM)	MAXIMUM INJECTION (GPM)
33.1-33.2	120	130	34	51
33.5-33.6	140	130	34	53
32.2-32.5	170	120	31	56
2.1-2.7	200	50 #3 100 #4	13.0 #3 26 #4	59
1.1-1.7	310	50 #3 110 #4	13.0 #3 26 #4	71

= SAND NUMBER

TABLE IV-6. WATER LEVELS WITH RESPECT TO THE ORE.

WELL NO.	AQUIFER CONFINEMENT	MINERALIZED SAND	HEAD ABOVE ORE (ft)
RI-3	ONLY SLIGHTLY CONFINED (≈40 FT)		≈115
RI-28	CONFINED (≈50 FT)		120
RI-1	CONFINED	1-2	60
RI-2	CONFINED (≈70 FT)	1-2 SANDS 3-4 SANDS	85 175
RI-4	UNCONFINED	1-2	30
RI-5	UNCONFINED	2-3	10 1ST 30 2ND 50 3RD
RI-6	UNCONFINED	2-3	25
RI-7	SLIGHTLY CONFINED	1-3	40
RI-16	UNCONFINED	2-3	15
RI-18	UNCONFINED	2-3	20
RI-14	UNCONFINED	2-4	60 SOME ABOVE
RI-9	CONFINED	2-3	80
RI-10	SLIGHTLY CONFINED	3-4	25 1ST 55 2ND
RI-11	CONFINED	3-4	60
RI-12	UNCONFINED	1-4	?

ADDENDUM 6C2:

RENO CREEK PROJECT
DEMONSTRATED RESTORATION REPORT

October 2008

RENO CREEK PROJECT

DEMONSTRATED RESTORATION REPORT

Research and Development

Uranium Solution Mining Operation

Campbell County, Wyoming

R & D Permit No. TFN 1 4/192
Source Material License SUA - 1338

November, 1981

Rocky Mountain Energy Company

RENO CREEK

DEMONSTRATED RESTORATION REPORT

OPERATIONAL SUMMARY

Mining Phase

Leaching of Pattern 2 at Reno Creek started on October 7, 1980 when addition of lixiviant began. Pattern 2 is a modified 5-spot pattern consisting of 4 injection wells, 2 production wells and 6 monitor wells. Drawing No. C-001 shows the location and well configuration of the pattern.

Production rates were initially set at 25 gpm with 20 gpm injection and later adjusted to 23 gpm production with the same (20 gpm) injection flow rate.

Leaching operations continued from October 7 to December 22, 1980 during which time approximately 10 aquifer pore volumes were circulated through the production zone and 1200 lbs. of uranium recovered. The lixiviant used was a sodium bicarbonate solution and hydrogen peroxide used as the primary oxidant.

Restoration Phase

Restoration of the test pattern began December 22, 1980 when chemical refortification of lixiviant was discontinued. Circulation of production fluid through the wellfield and the processing plant to lower uranium concentration began.

During the initial phase of restoration, it was suggested that pretreatment of the production fluid by an ion exchange process prior to R/O would greatly speed restoration. Accordingly, IX columns were prepared to strip divalent cations from the production fluid by means of a weak acid resin. Evaluation of the effectiveness of this treatment method indicated that the ion exchange process was performing well enough to eliminate the need for R/O treatment. Figure 1 shows the actual restoration circuit used and the reverse osmosis circuit originally proposed (indicated by dashed line flow streams).

Groundwater restoration using the ion exchange resin began on February 17, 1981. This phase of the restoration program continued until March 13, 1981 during which time approximately 2 pore volumes were circulated through the leached pattern.

Analysis of production zone water quality following this restoration phase indicated that groundwater affected during leaching had been restored to background ranges for the parameters of concern, with the exception of uranium and vanadium. Uranium levels were effectively reduced from about 15 mg/l to less than 2 mg/l while vanadium concentrations dropped to approximately 1 mg/l. Both elements remained in the 1 to 2 mg/l range during the final 10 days of IX treatment without dropping noticeably.

TABLE I

RENO CREEK PATTERN 2
PRODUCTION ZONE WATER QUALITY

Parameter[1]	Baseline 2 Range	Phase I (Leaching)	Phase II (Post Leach)	Phase III (Post IX)	Phase IV (Post Sweep)
pH	8.2–8.9	7.2	7.4	7.7	7.7
Cond.	1890–2234	3500	3400	2000	1995
HCO_3	89–178	1800	1670	160	125
Ca	108–153	330	207	69	87
Cl	7.0–18.8	240	113	19	15
Na	287–360	900	770	305	322
Fe	0.03–0.61	8.0	0.6	0.16	0.39
[illegible]O_8	0.012–0.287	65	16	1.64	1.37
[illegible]	0.05–0.34	6	3	1.05	0.45
[illegible]-226	106–768	-	311	238	222

[1] All values expressed as mg/l except pH (standard units) conductivity (μmhos/cm) and Ra 226 (pCi/l).

[2] Baseline range is for all Pattern II wells following removal of outlying data points.

TABLE III

RENO CREEK
Pattern 2
Restoration Data

PARAMETER[1]	Baseline Range[2]	WELL P-10 04/16/81 NML	WELL P-10 04/16/81 CDM	WELL P-11 04/16/81 NML	WELL P-11 04/16/81 CDM
Field					
pH	8.16-8.94	7.6	-	7.8	-
Conductivity	1890-2234	2000	-	1990	-
Major Constituents					
Bicarbonate (HCO_3)	89-178	121	129	126	122
Carbonate (CO_3)	0-14	0	0	0	0
Alkalinity (as $CaCO_3$eq)	73-146	99	107	103	101
Calcium	108-153	100	85	84	79
Chloride	7.0-18.8	18	13	16	11
Magnesium	19-33	31	21	14	21
Potassium	5.8-9.5	7.7	6.5	10.0	6.4
Sodium	287-360	321	290	346	330
Sulfate	818-1002	892	820	885	804
TDS	1340-1580	1560	1497	1520	1440
Anion/Cation Balance	-	104%	104%	102%	94%
Minor Constituents					
Ammonia as N	<0.2	-	<0.2	-	<0.2
Nitrate as N	<0.05	-	<0.05	-	<0.05
Nitrite as N	<0.05	-	<0.05	-	<0.05
Aluminum	<0.2	0.1	<0.5	<0.1	<0.5
Arsenic	0.001-0.016	-	0.009	-	0.009
Barium	0.08-0.40	-	<0.2	-	<0.2
Boron	<0.1	0.1	<0.1	<0.1	<0.1
Cadmium	0.01-0.02	0.01	<0.01	0.01	<0.01
Chromium	0.02-0.11	0.15	<0.02	0.15	<0.02
Copper	0.01-0.02	0.01	<0.05	0.02	<0.05
Fluoride	0.09-0.15	0.2	0.1	0.16	0.10
Iron	0.03-0.61	0.30	0.21	0.48	<0.05
Lead	0.03-0.11	0.08	<0.005	0.07	<0.005
Manganese	0.01-0.14	0.06	<0.05	0.09	<0.05
Mercury	<0.0001	-	<0.0001	-	<0.0001
Molybdenum	0.01-0.11	0.03	<0.005	0.08	0.012
Nickel	0.01-1.10	0.06	<0.05	0.07	<0.05
Selenium	0.009-0.017	-	0.010	-	0.010
Vanadium	0.05-0.34	0.42	0.36	0.53	0.47
Zinc	0.01-0.09	0.01	0.01	0.01	0.02
Radiochemistry					
Uranium as U_3O_8	0.012-0.287	0.97	1.6	1.20	1.7
Radium - 226	106-768	241	220	253	175
Thorium - 230	0 - 1.9	3.3	1.4	<0.6	1.3

[1]All values expressed as mg/l except pH (std. units), conductivity (umhos/cm) radium and thorium (pCi/l).

[2]Baseline range is for all pattern wells following outlier removal.

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TABLE IV

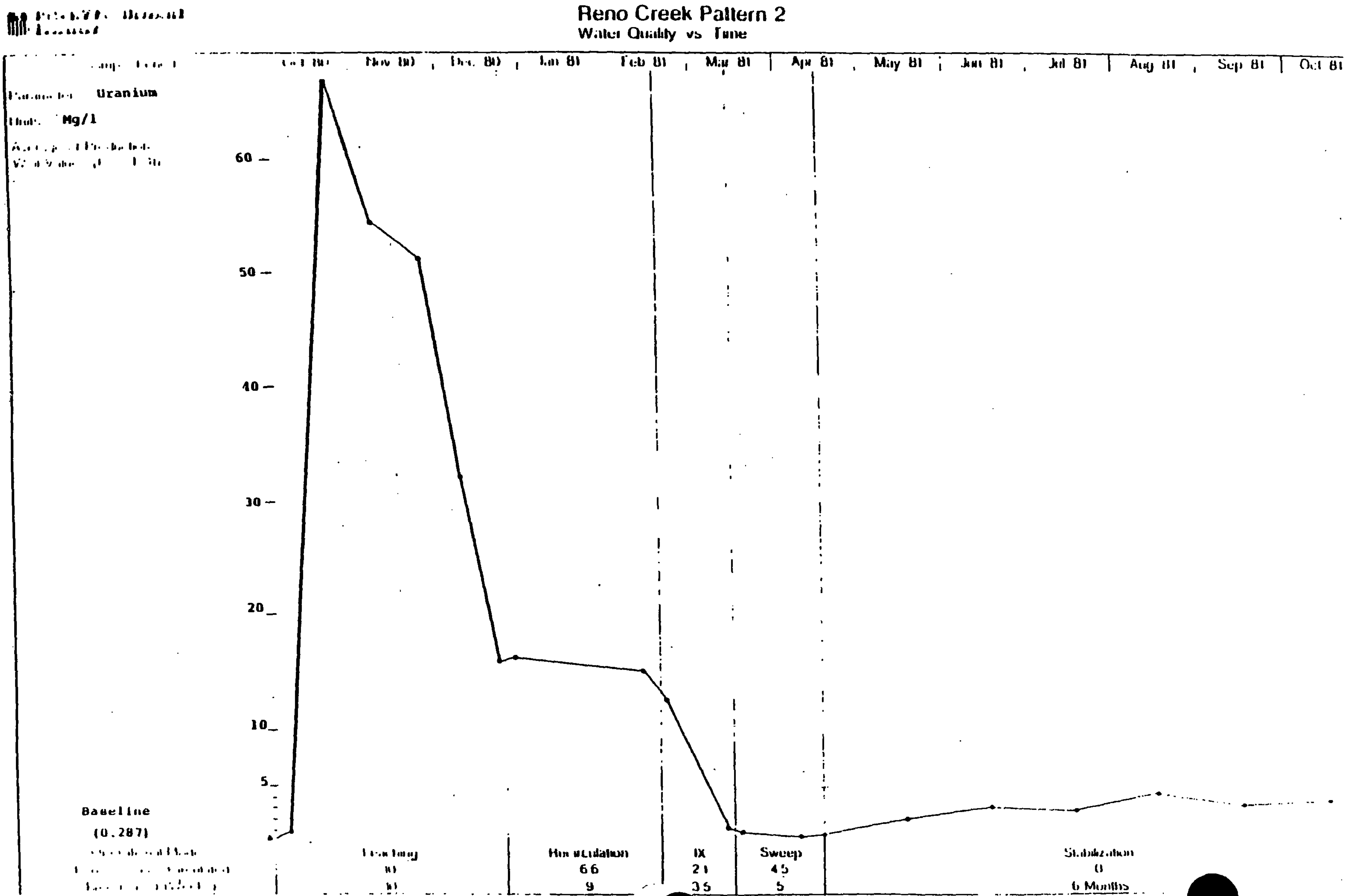
RENO CREEK
PATTERN 2 INJECTION WELLS
RESTORATION WATER QUALITY

PARAMETER	WELL I-12 04/16/81 NML	CDM	WELL I-13 04/16/81 NML	CDM	WELL I-14 04/16/81 NML	CDM	WELL I-15 04/16/81 NML	CDM
Field								
pH	7.8	—	7.8	--	7.9	--	7.7	—
Conductivity	1990	—	2093	—	2000	—	2000	—
Major Constituents								
Bicarbonate (HCO_3)	133	136	119	136	119	126	123	129
Carbonate (CO_3)	0	0	0	0	0	0	0	0
Alkalinity	109	112	98	112	98	104	101	107
Calcium	87	72	82	69	84	77	101	95
Chloride	15	10	15	10	18	13	28	14
Magnesium	29	26	24	24	36	28	49	31
Potassium	12	7.4	10.0	7.0	12	8.0	13	8.8
Sodium	332	290	363	340	341	320	328	300
Sulfate	917	936	917	940	948	900	934	934
TDS	1500	1400	1560	1460	1500	1450	1560	1490
Anion/Cation Bal.	96%	119%	97%	108%	100%	104%	94%	107%
Minor Constituents								
Arsenic	0.010	0.010	0.009	0.009	0.007	0.007	0.005	0.005
Cadmium	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Copper	0.02	0.05	0.01	0.05	0.01	0.05	0.01	0.05
Fluoride	0.14	0.1	0.10	0.1	0.16	0.2	0.10	0.1
Iron	0.02	0.05	0.06	0.12	0.04	0.05	0.05	0.05
Lead	0.01	0.005	0.01	0.005	0.01	0.005	0.01	0.005
Manganese	0.09	0.05	0.04	0.05	0.05	0.05	0.01	0.05
Molybdenum	0.01	0.007	0.01	0.009	0.01	0.007	0.01	0.005
Nickel	0.03	0.05	0.04	0.05	0.04	0.05	0.06	0.05
Selenium	0.026	0.026	0.007	0.007	0.017	0.017	0.009	0.009
Vanadium	0.48	0.440	0.74	0.700	0.39	0.280	0.36	0.250
Zinc	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Radiochemistry								
Uranium (as U_3O_8)	2.79	4.5	0.81	1.2	1.19	1.9	0.47	0.82
Radium-226	119	101±9	142	107±9	130	98±9	106	133±10
Thorium-230	5.4	1.6±0.6	1.6	0.2±0.3	1.9	0.1±0.3	0.4	0.7±0.4

NOTE
The following parameters were non-detectable: Ammonia, Nitrate, Nitrite Aluminum, Barium, Boron, Chromium, Mercury.

All values reported as mg/l except pH (std. units), conductivity (μmhos/cm), radium and thorium (pCi/l).

28/D1



Reno Creek Pattern 2
Water Quality vs Time
Parameter Uranium
Units Mg/l
Nov 80
Dec 80
Jan 81
Feb 81
Mar 81
Apr 81
May 81
Jun 81
Jul 81
Aug 81
Sep 81
Oct 81
60
50
40
30
20
10
5
Baseline
(0.287)
Sweep
45
5
IX
21
35
66
9
6 Months

Reno Creek Pattern 2

Water Quality vs. Time

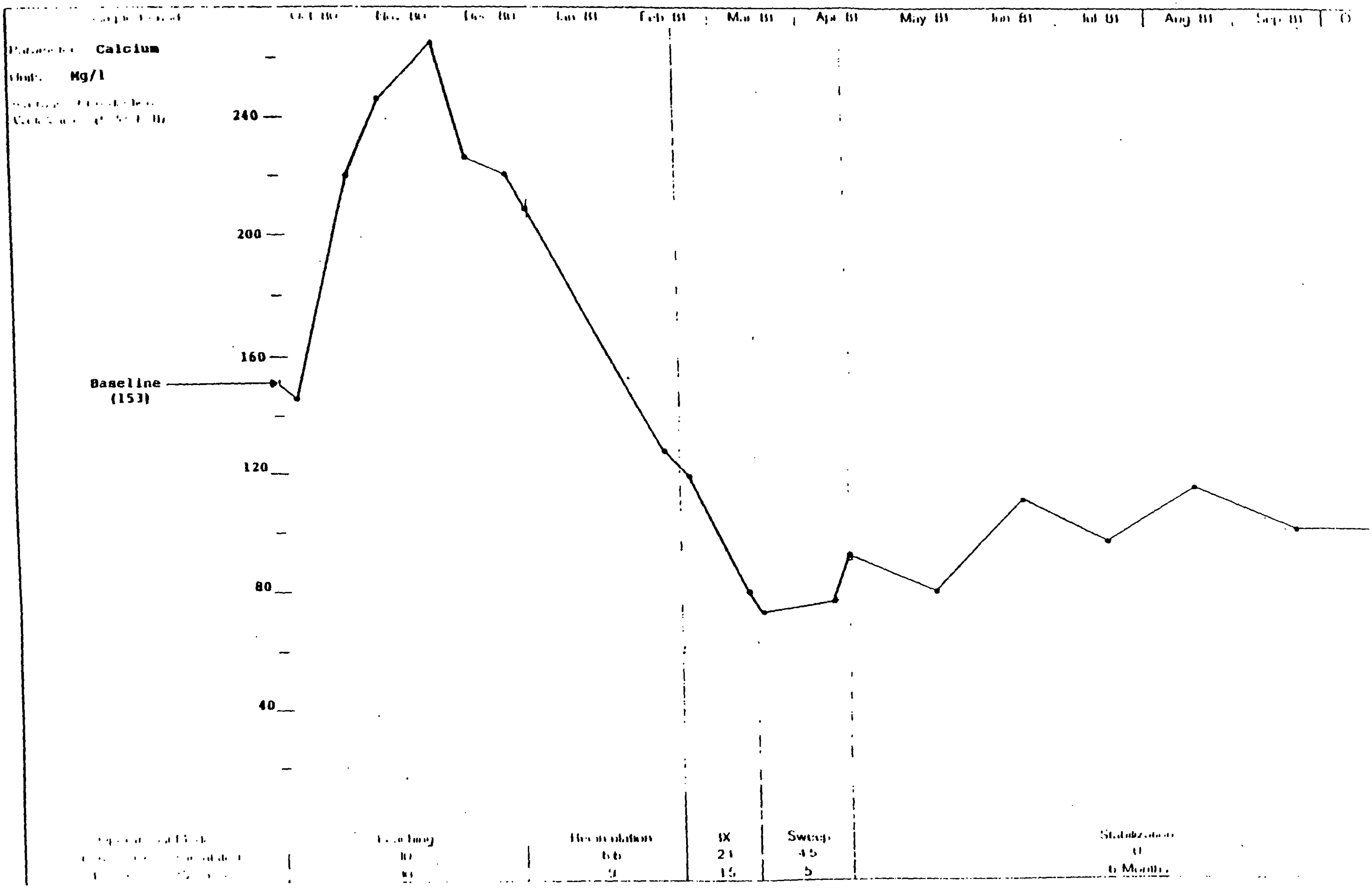
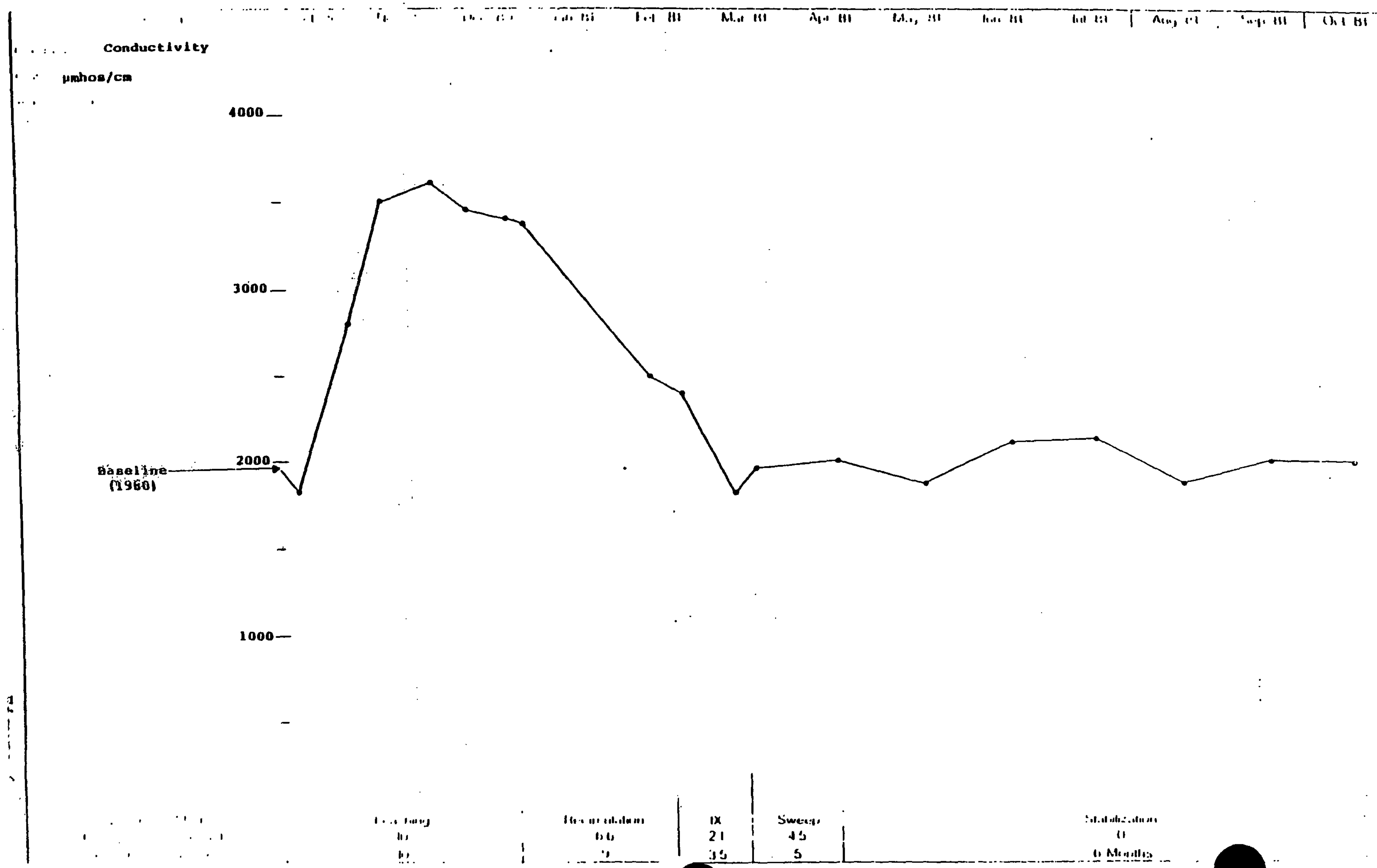


Figure 7

Reno Creek Pattern 2
Water Quality vs. Time



III through IV-A. Samples collected during the interim four month period were analyzed for pH, conductivity, TDS, bicarbonate, chloride, uranium and vanadium. Table V and Figures 7,8, and 9 respectively give interior well data and depict water quality stability for three key parameters. As previously noted, the pattern average for these parameters is also shown.

Appendices A and B present water quality for the pattern monitor wells, as determined by two laboratories, at the conclusion of the six month demonstrated restoration period. Appendix C summarizes pre-mining water quality for the entire pattern as well as describing results of individual well analyses. The data clearly indicates that water quality in the vicinity of the monitor wells is well within baseline range.

Conclusion

The primary objectives of the Pattern 2 test were to:

1) evaluate the performance of a carbonate lixiviant in the Reno Creek orebody with respect to uranium concentrations in pregnant solution (e.g. head grades) and

2) demonstrate a restoration method which would be environmentally and operationally acceptable for a production mine facility at Reno Creek.

These objectives have been fully met.

Analysis of the groundwater quality data and graphs confirm that stabilization of water quality within the restored pattern has been demonstrated. All groundwater constituents except uranium have stabilized at levels below or approximating pre-mining water quality. Uranium levels within the pattern interior are well below the Wyoming drinking water standard of 5 mg/l. Initial and final well samplings indicate there was no mobilization or build up of toxic elements such as arsenic, mercury or selenium as a result of mining activities. Total Dissolved Solids (TDS) levels are well below baseline range indicating overall improvement in water quality.

All post restoration data supports the conclusion that affected groundwater can be returned to a condition such that its quality of use is equal to or better than and consistent with premining use suitability.

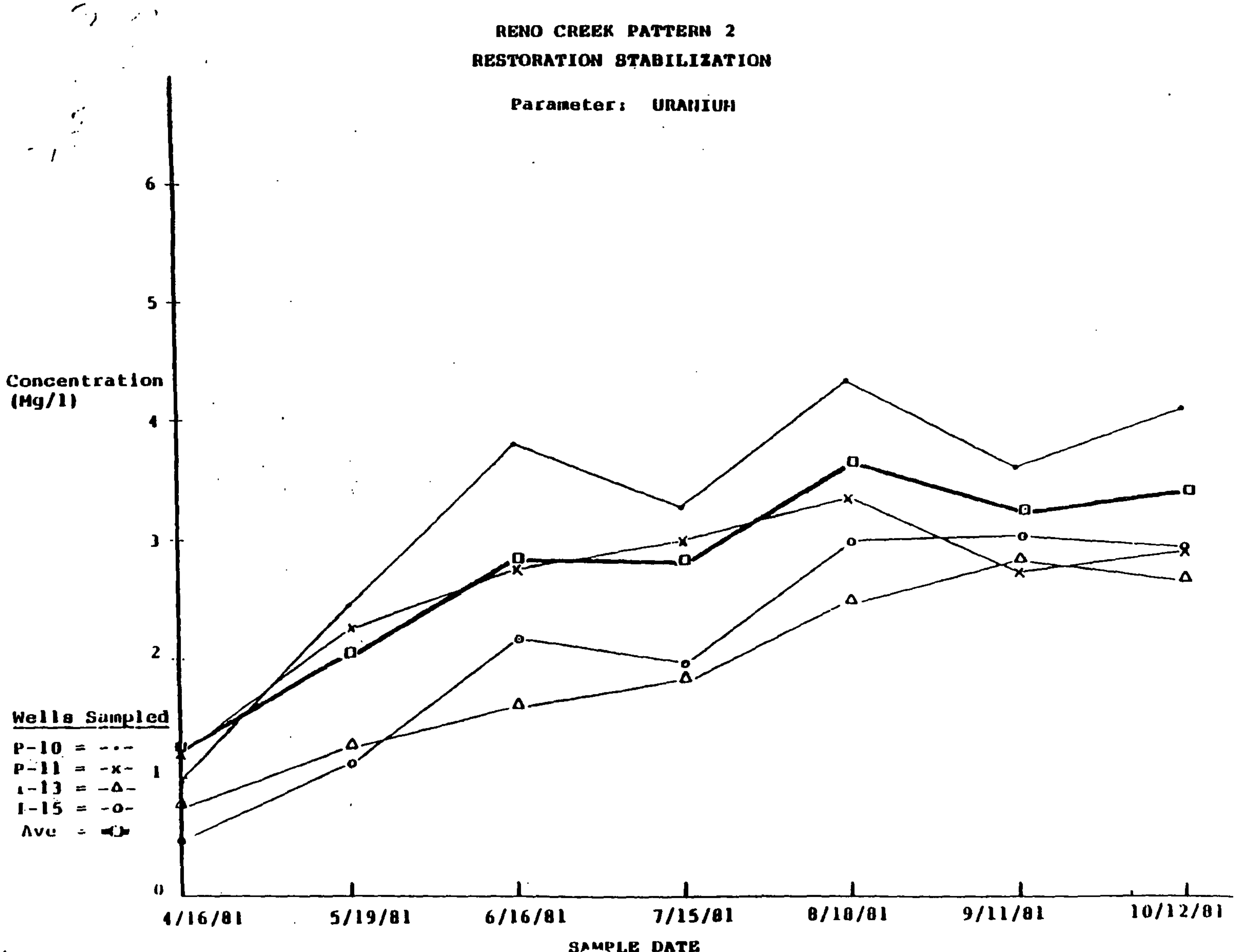
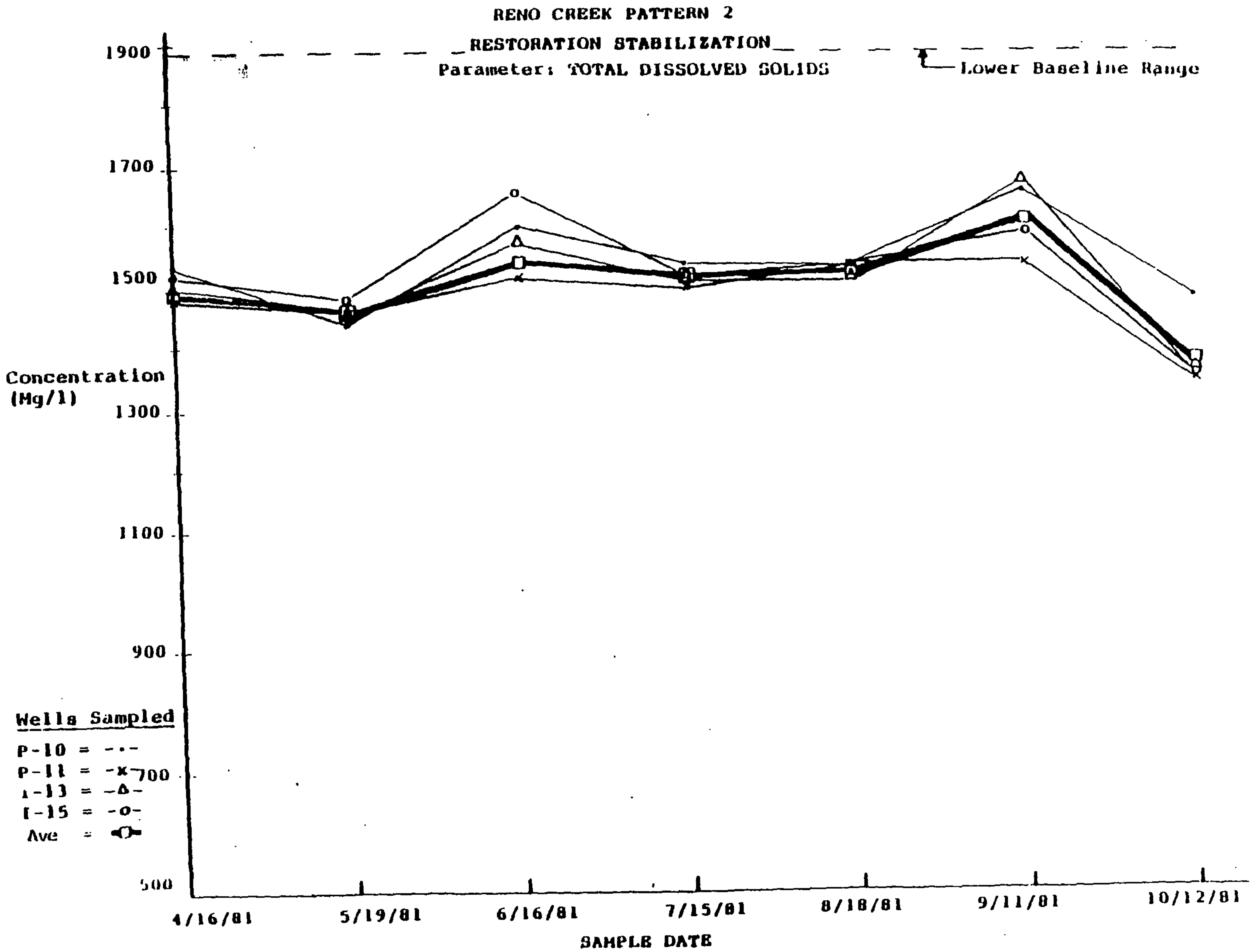


Figure 7

AVERAGE ... LINEAR & SEMI-LOG COMPARISON

FIGURE 7



RENO CREEK PATTERN 2
RESTORATION STABILIZATION
Parameter: TOTAL DISSOLVED SOLIDS
Lower Baseline Range
1900
1700
1500
1300
1100
900
700
500
Concentration (Mg/l)
Wells Sampled
P-10 = -•-
P-11 = -x-
I-13 = -Δ-
I-15 = -o-
Ave = -□-
4/16/81
5/19/81
6/16/81
7/15/81
8/18/81
9/11/81
10/12/81
SAMPLE DATE

Figure 9

ADDENDUM 6C3:

HYDROLOGIC ANALYSIS OF THE RENO CREEK-PATTERN 2 PROPERTY FOR IN SITU URANIUM RECOVERY

October 2008

HYDROLOGIC ANALYSIS
OF THE
RENO CREEK - PATTERN 2
PROPERTY
FOR IN SITU URANIUM RECOVERY

JUNE, 1981

Hydrologist

General Manager Engineering

Manager Mine Engineering

Vice President Technical Services

ROCKY MOUNTAIN ENERGY
TECHNICAL SERVICES
BROOMFIELD, COLORADO

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LIST OF FIELD DATA

1.0 INTRODUCTION

The Reno Creek project site is located in the Powder River Basin approximately nine miles southwest of Reno Junction in south-central Campbell County, Wyoming (Figure 1). This report presents the results of the hydrology of Pattern 2. It follows the 1979 report which evaluates the regional hydrology and the first intensive pattern of the Reno Creek property. (Refer to the report, "Hydrologic Evaluation of the Reno Creek Property for In-Situ Uranium Recovery", by Way, et al, in regards to the regional baseline hydrology, the detailed hydrology of Pattern 1, the related geology, previous investigations and test preparation and procedures which are pertinent to the hydrologic analysis of Pattern 2.) Due to the similar hydrologic environments of Patterns 1 and 2 and the method of analysis and assumptions used, several parts of the Pattern 1 report have been incorporated herein.

The combination four-spot well field pattern (Figure 2) is completed to select mineralized zones within the 125-foot ore sand in the Wasatch Formation. The pattern consists of two central recovery wells with four injection wells spaced approximately 35 feet from the center of the pattern. Six monitor wells were drilled to detect any possible excursions of lixiviant during the leaching operation. Four monitor wells are located in the mineralized sand unit and are perforated over the entire thickness of the sand. One monitor well was drilled and completed into the upper sand unit and one into the lower sand unit.

The upper sand unit (approximately 150 to 190 feet) is separated from the ore sand by a sequence of mudstone, coal and shales. The lower sand unit (approximately 410 to 440 feet) is overlain by a 35-foot thick mudstone. Observations made during the pump test indicate that both upper and lower sands appear to be isolated from the ore sand and will not be affected by the leaching operation.

1.1 Purpose of Present Investigation

The purpose of this investigation is to perform a local site specific hydrologic study and to determine its relationship to Pattern 1 and to the regional hydrology. The test objectives were to determine the following:

1) Storage Coefficient
2) Mean Transmissivity and Permeability
3) Specific Capacity
4) Location of a hydraulic boundary, if any
5) Extent of hydraulic connection between production zone aquifer and adjacent aquifer
6) Degree of hydraulic connection between the production zone and the monitor wells
7) Local piezometric map
8) Direction and magnitude of groundwater flow
9) Spatial variation of transmissivity.

The intensive pattern was designed primarily to provide permeability, production and injection well characteristics. One multi-well aquifer test was performed using well P10 as the pumped well, nine production sand monitor wells, one upper sand monitor well and one lower sand monitor well. The flow rate was maintained at 18.7 gpm. Four injection tests on wells I12, I13, I14 and I15 were also performed, not to determine specific capacities and well efficiencies, but to ensure that comparable injection rates would lead to an operational pattern. Water level measurements were recorded in adjacent monitor wells to observe the degree of hydraulic connection within the production zone.

2.0 SUMMARY AND CONCLUSIONS

The Wasatch Formation is the host sand for the known uranium deposit of the study area. The average thickness and porosity of the mineralized or production aquifer are respectively, 121 feet and 28 percent. The upper and lower confining mudstones were found to be good confining layers as indicated by the lack of decline in water levels in both the upper and lower sand monitor wells. Static water levels resided within 12 feet of the top of the aquifer. Response to pumping was that of a water table aquifer.

Unlike Pattern 1, where the multi-well aquifer test utilized a pumped well (OB-1) that was completed over the entire thickness of the ore sand, the multi-well aquifer test for Pattern 2 was performed using pumped well P10 which is partial penetrating and completed only to select mineralized zones within the ore sand. Therefore, the Boulton and Streltsova method was used to analyze individual well drawdown data on wells P10, I12, I13, I14 and I15. This method accounts for partial penetrating wells in an unconfined, compressible aquifer.

Boulton's water table delayed type curve method was used to analyze individual well drawdown data on wells M16, M17, M18 and M19 which are perforated over the entire thickness of the aquifer. These methods as well as others will be discussed in a later section.

The four injection tests on wells I12, I13, I14 and I15 were performed in order to determine optimum injection rates that may be used for the operational pattern and to observe the degree of hydraulic connection within the production zone. All wells, except I13, functioned efficiently at an 11 to 17 gpm injection rate. Well I13 pressured up after the injection of one casing volume. This was attributed to a partially cemented underreamed zone. This well has now been cleaned out and is functioning properly.

The values obtained from the Pattern 2 multi-well aquifer test are as follows:

Storage Coefficient	8.8×10^{-3}
Geometric Mean Transmissivity (single well analysis)	1757 gpd/ft. (0.96 darcy)
Major Transmissivity	2765 gpd/ft. (1.54 darcies)
Minor Transmissivity	406 gpd/ft. (0.22 darcy)
Specific Capacity (measured) - Pumped Well P10	0.83 gpm/ft.
Well Efficiency - Pumped Well P10	57%[1], 24%[2]

The local piezometric surface over the Pattern 2 property (Figure 8) has a hydraulic gradient of 0.0017 ft/ft. and is consistent with that of Pattern 1. But the direction of groundwater flow, N.9°W, is dissimilar to Pattern 1 (N.36°E) and to the regional

[1]Agarwal, et al Method

[2]Straight Line Method

piezometric surface (N.40°E). This is attributed primarily to the operation of Pattern 1 when the water level measurements were recorded on July 11, 1980. Local variations in the direction and velocity of groundwater flow are also affected by the heterogeneity and anisotropy of the aquifer. The calculation of groundwater flow for Pattern 2 is 4.3 ft/yr. using a mean hydraulic conductivity of 1.94 ft/d and a porosity of 28 percent. The flow is in the direction of the dip of the gradient. Depth to water below land surface in wells completed into the production zone is approximately 260 feet.

The regional piezometric surface map (Figure 7) from the first report has been included for the purposes of comparing local and regional piezometric surfaces.

3.0 WELL LOCATION AND CHARACTERISTICS

Figure 2 is the cross section index and indicates the relative locations of wells which were monitored during the multi-well aquifer test. Injection wells I12, I13, I14 and I15 were drilled in a combination four-spot pattern around the two central production wells P10 and P11. Monitor wells M16, M17, M18 and M19 were drilled outside the pattern to monitor subsurface flow movement during solution mining operations.

Figures 3 and 4 show a vertical cross section of the pattern along a W-E and S-N direction, respectively.

Tables 1 and 2 summarize pertinent information concerning wells in the pattern. All wells were completed into the uranium host sand, except wells USM2 (upper sand monitor well 2) and LSM2 (lower sand monitor well 2), which were completed into the upper and lower sands.

The wells were drilled with mud, completed with 5 inch yelomine casing and cemented to the surface. Injection and production wells were selectively underreamed (drilled out to an open hole) within the ore zone, while the monitor wells were perforated over the entire aquifer thickness.

4.0 METHOD OF ANALYSIS AND ASSUMPTIONS

The static piezometric surface of the production aquifer resided below the top of the sand and response to pumping was, therefore, that of an unconfined or water table aquifer. Confined aquifer methods could not be applied in this situation. Instead, Boulton's unconfined, delayed-yield type curve method was used to analyze individual well data for the monitor wells (Figures 18-21) which were perforated over the entire thickness of the ore sand and the Boulton-Streltsova method, which accounts for partial penetrating finite wells, was used to analyze well data for the production and injection wells (Figures 13-17). The results are summarized in Table 3.

The following assumptions are made in the derivation of these two equations:

Boulton's Delayed-Yield

1) The formation is an unconfined aquifer.
2) The formation is homogeneous within the radius of influence.
3) The thickness of the aquifer is uniform.
4) The well is pumped at a constant rate.
5) The pumped well is open over the entire aquifer thickness.
6) The pumped well is of infinitesimal radius.

Boulton and Streltsova

1) The formation is an unconfined aquifer.
2) The formation is homogeneous within the radius of influence
3) The thickness of the aquifer is uniform.
4) The well is pumped at a constant rate.
5) The pumped well may be partial penetrating.
6) The pumped well may have a finite diameter.

7) Water is derived simultaneously from storage and delayed gravity drainage.

7) The aquifer is compressible and in general anisotropic, the horizontal and vertical permeabilities being constant.

8) The aquifer is underlain by a horizontal impermeable bed, which may be at any depth below the bottom of the pumped well.

The first four assumptions for both methods are the same and, essentially, may be applied to the individual data reduction for all wells in the pattern. By correlating the geophysical logs and the measured water levels, it has been determined that the aquifer is indeed unconfined and, therefore, satisfies the first assumption.

The assumption of homogeneity is substantiated by the degree of consistency of the hydrologic properties of the various wells. In reference to Table 3 regarding the transmissivity values, all wells, except P10 and I13, do not differ from a mean value of 2,094 gpd/ft. by more than ± 24 percent. The circular configuration of the drawdown contours (Figures 9 and 10) also assures to a great extent, the degree of homogeneity across the pattern.

The assumption of uniform thickness is easily checked by referring to the cross sections given in Figures 3 and 4 and the well data in Table 1. According to the cross sections and the individual geophysical log for each well, the aquifer thickness does not vary considerably from the average value of 121 feet.

Assumption 4 is satisfied since the flow rate was maintained at 18.7 gpm during the pump test.

Assumptions 5 and 6 are the primary reasons for using the two different methods in analyzing the data. The production and injection wells which were selectively underreamed within the production sand (Table 1) required a method (Boulton and Streltsova) which allowed for partial penetrating wells and a pumped well with a finite diameter. The monitor wells which were perforated over the entire aquifer thickness allowed the usage of Boulton's delayed-yield method which satisfies Assumption 5, but not Assumption 6, which can be justified because of the method of analysis used for the pumped well. Furthermore, it is of common knowledge that when the discharge of a pumping well is beyond the period of wellbore storage (approximately one minute in this case), the finite wellbore of the pumped well exerts no effect on the drawdown behavior of the observation (monitor) wells. Therefore, the two assumptions for both methods can be applied.

Assumption 7 concerning delayed gravity drainage and a compressible unconfined aquifer is somewhat controversial, but can be accepted as a viable assumption because of the similarity in the results of several different solutions and the methods of analysis used by a number of investigators.

The last assumption for the Boulton and Streltsova method is easily checked by referring to Figures 3 and 4. The production aquifer is underlain by a 35-foot thick mudstone.

We, therefore, conclude that the subsurface conditions were closely approximated by analytic solutions and the analytical

procedure used in the analysis was of sufficient accuracy to meet the study objectives and provide reliable values of the subsurface hydrologic properties.

5.0 DATA ANALYSIS

The multi-well aquifer test was performed on May 29, 1980. The test lasted for four hours at a constant flow rate of 18.7 gpm.

The value of transmissivity was fairly consistent over the pattern with a mean value of 1,757 gpd/ft. (0.96 darcy). The lowest value of 406 gpd/ft. (0.22 darcy) was observed in the pumped well P10 and the highest value of 2,765 gpd/ft. (1.54 darcies) in monitor well M16. The regional transmissivity contour map (Figure 5) from the Pattern 1 report has been included in this report for the purposes of comparing the Pattern 2 transmissivity data to the regional data. The average storage coefficient for Pattern 2 is 8.8×10^{-3}.

The calculated specific capacity (the ratio of the discharge rate, in gpm, to the water level change, in feet) was 0.83 gpm/ft. for the pumped well P10.

The well efficiency was also calculated for the pumped well P10 using the Agarwal et al method and the straight line method (Figures 11 and 12). Because these methods assume confined conditions and a pumped well that is open over the entire aquifer thickness, adjustments to the drawdown have been computed and shown on pp. 1 and 2 of the field data. The adjusted drawdown, s", was used in the calculation of well efficiency and found to be 57 percent (Agarwal et al) and 24 percent (straight line method).

The water levels in monitor wells M16, M17, M18 and M19 all responded to the pumping of well P10. The hydraulic connection

between the production zone and the monitor wells was, therefore, verified.

No hydraulic or impermeable boundaries were detected in the test.

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TABLES

RENO CREEK

PATTERN #2 WELL DATA

Well Name and Number[1]	Coordinates (ft.) N(Y)	Coordinates (ft.) E(X)	Top of Casing Elevation (ft.)	Ground Elevation (ft.)	Casing TD (ft.)
Production Wells					
P10	1,098,013.3	379,461.6	5,182.41	5,181.03	400
P11	1,098,000.0	379,447.1	5,182.17	5,181.22	400
Injection Wells					
I-12	1,097,982.9	379,428.8	5,183.78	5,181.43	400
I-13	1,098,022.7	379,437.6	5,182.26	5,180.31	400
I-14	1,098,030.3	379,479.2	5,183.89	5,182.21	400
I-15	1,097,989.5	379,471.2	5,183.74	5,182.24	400
Monitor Wells					
M16	1,097,998.2	379,651.3	5,192.09	5,190.62	400
M17	1,097,796.8	379,448.6	5,192.48	5,191.10	400
M18	1,097,998.7	379,248.5	5,188.12	5,186.77	400
M19	1,098,199.6	379,450.0	5,186.25	5,184.85	400
USM-2	1,097,936.21	379,446.15	5,185.17	5,183.30	190
LSM-2	1,098,077.14	379,447.75	5,183.03	5,181.00	400

[1] Five-inch well

TABLE 1

RENO CREEK

PATTERN #2 WELL DATA

(Continued)

Well Name and Number	(Perforated Interval) # Perforations (ft.)	Under-Reamed Interval (ft.)	Total Thickness of Reamed/Perforated Interval (ft.)	Top Sand[2]	Bottom Sand[2]	Depth to Water Level (ft.)[3]	Piezometric Surface Elevation (ft.)[4]
Production Wells							
P10		(285-310) (330-335)	25 5	244	370	255.20	4,927.21
P11		(285-310)	25	244	370	255.00	4,927.17
Injection Wells							
I-12		(290-303)	13	244	370	256.74	4,927.04
I-13		(288-301)	13	244	370	255.18	4,927.08
I-14		(293-304) (332-338)	11 6	245	373	256.80	4,927.09
I-15		(292-305)	13	245	370	256.66	4,927.08
Monitor Wells							
M16	(262-374) 336		112	259	375	264.80	4,927.29
M17	(269-377) 324		108	256	378	265.21	4,927.27
M18	(258-378) 360		120	252	379	261.10	4,927.02
M19	(257-353) 288		96	258	353	259.16	4,927.09
USM-2		(150-190)	40	151	190	152.75	5,032.42
LSM-2		(400-440)	40	410	440	260.40	4,922.63

[2] From ground elevation; average aquifer thickness = 121 ft.

[3] From top of casing

[4] Measured on May 27, 1980

TABLE 2

Distance from Pumped to Observation Wells

Pattern #2

Well No.	Well Type	Casing Size	Distance to the Pumped Well (Ft.)*
I12	Observation	5"	44.7
I13	Observation	5"	25.8
I14	Observation	5"	24.5
I15	Observation	5"	25.7
P10	Pumped	5"	0.0
P11	Observation	5"	19.7
M16	Observation	5"	190.3
M17	Observation	5"	216.9
M18	Observation	5"	213.6
M19	Observation	5"	186.7
LSM-2	Observation	5"	65.3
USM-2	Observation	5"	78.6

*Measured at land surface

TABLE 3

Summary of Pump Test Results, Pumped Well P10

Pattern #2

Well No.	Transmissivity (gpd/ft)	Hydraulic Conductivity[1] (gpd/ft^2)	Permeability[1] (darcies)	Storage Coefficient (dimensionless)	Leakage
P10	406	3.58	0.22	--	No
I12	2,296	21.80	1.32	9.6×10^{-4}	No
I13	745	6.38	0.39	4.4×10^{-2}	No
I14	1,714	14.97	0.91	7.9×10^{-4}	No
I15	1,837	16.00	0.97	7.7×10^{-4}	No
M16	2,765	25.44	1.54	5.3×10^{-3}	No
M17	2,143	19.24	1.17	7.6×10^{-3}	No
M18	2,093	17.97	1.09	5.4×10^{-3}	No
M19	1,813	19.61	1.19	5.5×10^{-3}	No

[1]Value calculated using m, the saturated aquifer thickness.

MATHEMATICAL FORMULAS

I. Agarwal, Al-Hussainy and Ramey's Type Curve Method

Ref. Earlougher, Jr., R.C., Advances in Well Test Analysis, Monograph Volume 5, Society of Petroleum Engineers of AIME, 1977.

$$T = \frac{114.6Q}{s} \left[2\ P_D + 2\ \text{skin}\right] \qquad (1.1)$$

$$w(u) = 2\ P_D \qquad (1.2)$$

where

T = transmissivity, gpd/ft.
s = drawdown, ft.
Q = well discharge, gpm
P_D = dimensionless pressure value
skin = skin effect, a dimensionless pressure drop assumed to occur at the wellbore face as a result of wellbore damage or improvement.
$w(u)$ = well function.

Example: See Figure 11.

$$\text{Well loss} = \frac{114.6Q}{T} (2\ \text{skin}) \qquad (1.3)$$

$$\text{Well efficiency} = \frac{\text{drawdown measured - well loss}}{\text{drawdown measured}} \qquad (1.4)$$

Example: Single well pump test on P10 (Figure 11).

Q = 18.7 gpm

skin = 20

adjusted drawdown = 7.46 ft. at t = 100 minutes

T = 26,788 gpd/ft.

hence, using equation (1.3)

$$\text{Well loss} = \frac{114.6 \times 18.7 \text{ gpm}}{26{,}788 \text{ gpd/ft.}} (2 \times 20)$$

$$= 3.20 \text{ feet}$$

Substitute well loss = 3.20 feet into equation (1.4)

$$\text{Well efficiency} = \frac{7.46 \text{ ft.} - 3.20 \text{ ft.}}{7.46 \text{ ft.}} \times 100\%$$

$$= 57\%$$

II. Straight Line Method

Ref: 1) Earlougher, Jr., R.C., Advances in Well Test Analysis, Monograph Volume 5, Society of Petroleum Engineers of AIME, Chapter 3, 1977.

2) Todd, D.K., Ground Water Hydrology, John Wiley and Sons, Inc., 1959.

$$T = \frac{264Q}{\Delta s} \tag{6.1}$$

$$K = \frac{T}{m} \tag{6.2}$$

$$k = 1{,}000\ \frac{K}{a} \tag{6.3}$$

$$\text{skin} = 1.151 \left[\frac{s_{1hr.}}{\Delta s} - \log \left(\frac{k}{\phi \mu C_T r_w^{\,2}} \right) + 3.23 \right] \tag{6.4}$$

where

T = transmissivity, gpd/ft.

Q = well discharge, gpm

Δs = change in drawdown, in feet, per log cycle of t

t = time since pumping started, minutes

K = hydraulic conductivity, gpd/ft^2.

m = saturated aquifer thickness, feet

k = permeability, millidarcy

a = conversion factor from permeability (darcy) to hydraulic conductivity (gpd/ft.^{2}), a = 16.5 for water at 12°C

skin = skin factor

$s_{1hr.}$ = drawdown value at t = 1 hour on s(ft.) vs. log t (minutes) plot

ϕ = porosity

μ = viscosity, cp

C_T = formation total compressibility, psi^{-1}

r_w = well radius, ft.

Example: See Figure 12

$$\text{Well loss} = \frac{114.6Q}{T} (2 \times \text{skin}) \tag{6.5}$$

$$\text{Well efficiency} = \frac{s_w - \text{well loss}}{s_w} \times 100\% \tag{6.6}$$

where

s_w = pumped well adjusted drawdown, ft. at 100 minutes

Example: Single Well Pump Test on Well P10 (Figure 12)

Q = 18.7 gpm

skin = 24.84

T = 18,280 gpd/ft.

s_w = 7.63 ft. at t = 100 minutes

$$\text{Well loss} = \frac{114.6 \times 18.7 \text{ gpm}}{18{,}280 \text{ gpd/ft.}} (2 \times 24.84)$$

$$= 5.82 \text{ feet}$$

$$\text{Well efficiency} = \frac{7.63 - 5.82}{7.63} \times 100\% = 24\%$$

III. Boulton and Streltsova Analysis

Ref: Boulton, N.S. and Streltsova, T.D., 1976. The Drawdown Near an Abstraction Well of Large Diameter under Non-steady Conditions in an Unconfined Aquifer. J. Hydrol., 30: pp. 29-46.

$$T = \frac{Q}{4\pi s} \sum_{n=1,3,5,\ldots}^{\infty} G_n \sin\frac{n\pi y'}{2} \left[\frac{\pi K_0(\xi_n r/r_w)\{1 - e^{-\phi_n \theta_w/4}\}}{K_1(\xi_n)[4S(\ell' - \ell'_1)\xi_n\{1 - S(\ell' - \ell'_1)\} + \phi_n^2/\xi_n} \right.$$

$$\left. + \int_0^{\infty} \frac{[P_2 J_0(\beta r/r_w) - P_1 Y_0(\beta r/r_w)][1 - e^{-\frac{\theta_w}{4}(\beta^2 + c_n^2)}]\beta d\beta}{(P_1^2 + P_2^2)(\beta^2 + c_n^2)} \right]$$

$$G_n = \frac{32S}{\pi^2}\left[\frac{1}{n}\left(\cos\frac{n\pi\ell'_1}{2} - \cos\frac{n\pi\ell'}{2}\right)\right]$$

$$P_1 = (\beta^2 + c_n^2)J_0(\beta) - 2(\ell' - \ell'_1)S\beta J_1(\beta)$$

$$P_2 = (\beta^2 + c_n^2)Y_0(\beta) - 2(\ell' - \ell'_1)S\beta Y_1(\beta)$$

$$c_n = n\pi\rho_w/2$$

$$\theta_w = 4Tt/(r_w^2 S)$$

ξ_n is the positive root of: $c_n^2 - \xi_n^2 = 2S(\ell' - \ell'_1)\dfrac{\xi_n K_1(\xi_n)}{K_0(\xi_n)}$

$$\phi_n = c_n^2 - \xi_n^2$$

where

T = transmissivity (L^2/T)

Q = well discharge (L^3/T)

s = drawdown (feet)

r = distance to the pumped well (feet)

r_w = radius of abstraction well (feet)

J_0 = Bessel function of the first kind of zero order

J_1 = Bessel function of the first kind of first order

K_0 = Modified Bessel function of the second kind of zero order

K_1 = Modified Bessel function of the second kind of first order

Y_0 = Bessel function of the second kind of zero order

Y_1 = Bessel function of the second kind of first order

h = Depth of aquifer below water table

k_h = Coefficient of permeability of aquifer in horizontal direction

k_v = Coefficient of permeability of aquifer in vertical direction

ℓ = Distance from water table to bottom of unlined part of abstraction well

$\ell' = \ell/h$

ℓ_1 = Distance from water table to top of unlined part of abstraction well

$\ell_1' = \ell_1/h$

y = Depth to any point below water table

$y' = Y/h$

β = independent variable of integration

$\mu = (k_v/k_h)^{1/2}$

$\rho = \mu r/h$

Example: See Figure 14.

IV. Boulton's Unsteady State Delayed Yield Type Curve Method

Ref: Lohman, S.W., Ground-Water Hydraulics, U.S. Geological Survey Professional Paper 708, 1972.

$$T = \frac{Q}{4\pi s} \int_0^\infty 2J_0 \left(\frac{r}{B}x\right) \left\{ 1 - \frac{1}{x^2-1} \exp\left(-\frac{\alpha t x^2}{x^2+1}\right) - \varepsilon \right\} \frac{dx}{x} \qquad (2.1)$$

$$\varepsilon = \frac{x}{x^2+1} \exp \{-\alpha n t \quad (x^2+1)\}$$

$$\alpha = \left(\frac{r}{B}\right)^2 T/r^2 S_e$$

$$n = \frac{S_e + S_1}{S_e}$$

$$U_e = \frac{r^2 S_e}{4Tt}$$

$$U_1 = \frac{r^2 S_1}{4Tt}$$

where

T = transmissivity (L^2/T)

Q = well discharge (L^3/T)

s = drawdown (feet)

r = distance to the pumped well (L)

B = delayed yield index (L)

J_0 = Bessel function of the first kind of zero order

S_e = storage coefficient of early stage

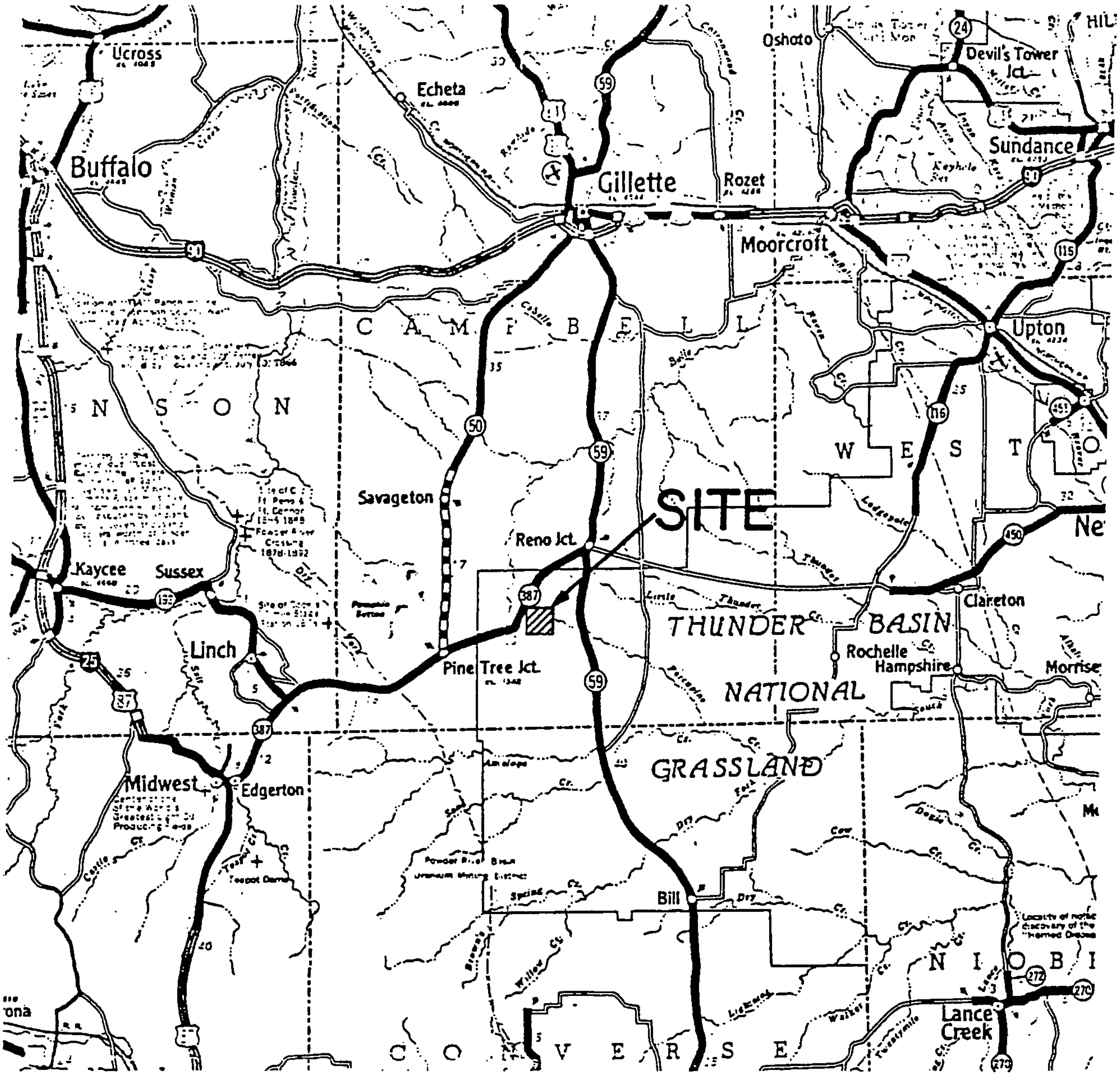
S_1 = storage coefficient of late stage

t = time since pumping started (T)

x = variable of integration

Example: See Figure 19.

FIGURES



REFERENCE

OFFICIAL HIGHWAY MAP OF WYOMING,
WYOMING STATE HIGHWAY COMMISSION,
DATED 1974.

N

0 5 10 20

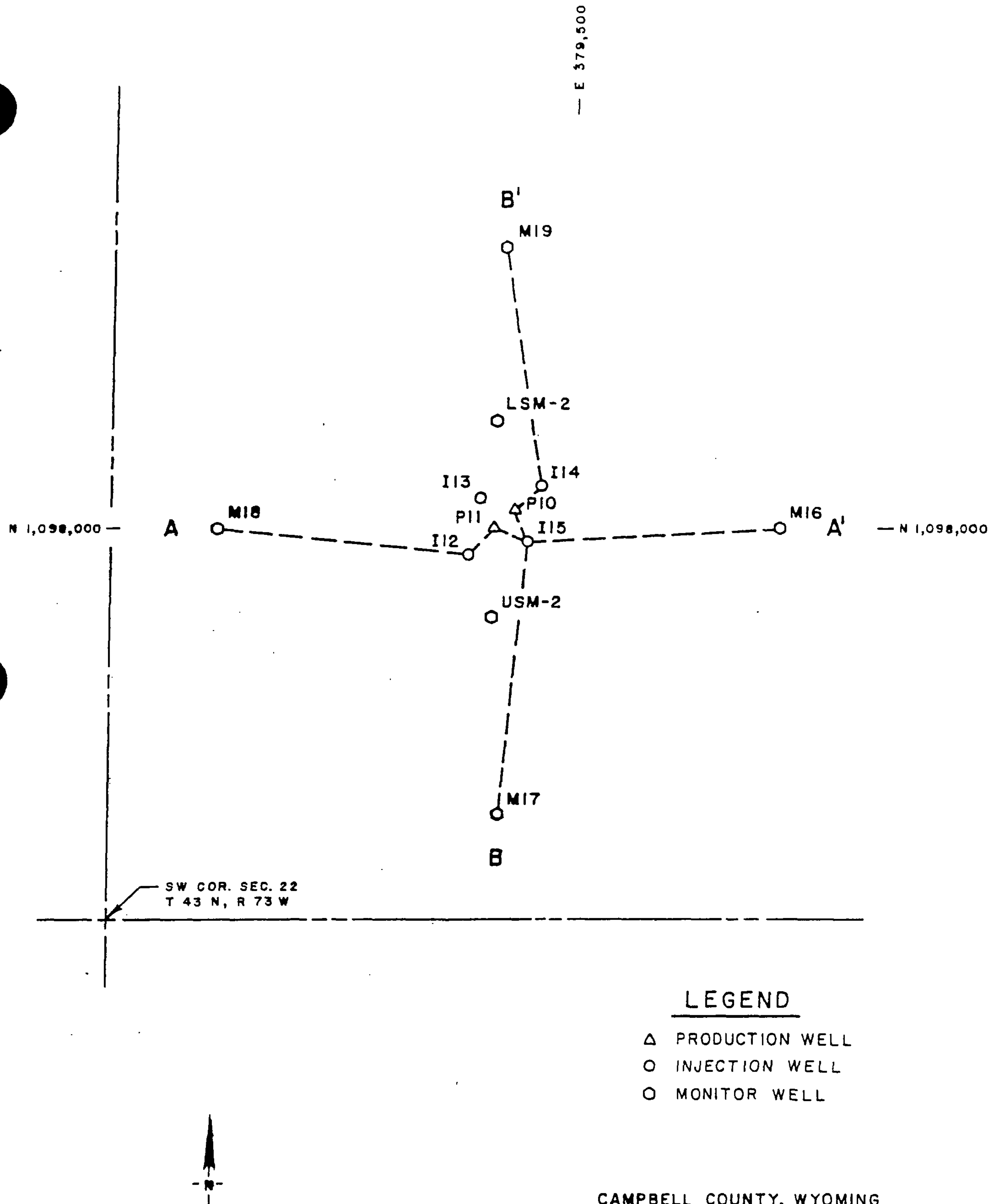
SCALE: 1" = APPROX. 18 MILES

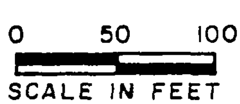
ROCKY MOUNTAIN ENERGY COMPANY
4704 HARLAN STREET, DENVER COLORADO 80212

RENO CREEK	REV
SITE LOCATION MAP	

DATE: JULY, 1979	DRAWN BY: VLS	FIGURE 1

37-02-G-074





CAMPBELL COUNTY, WYOMING

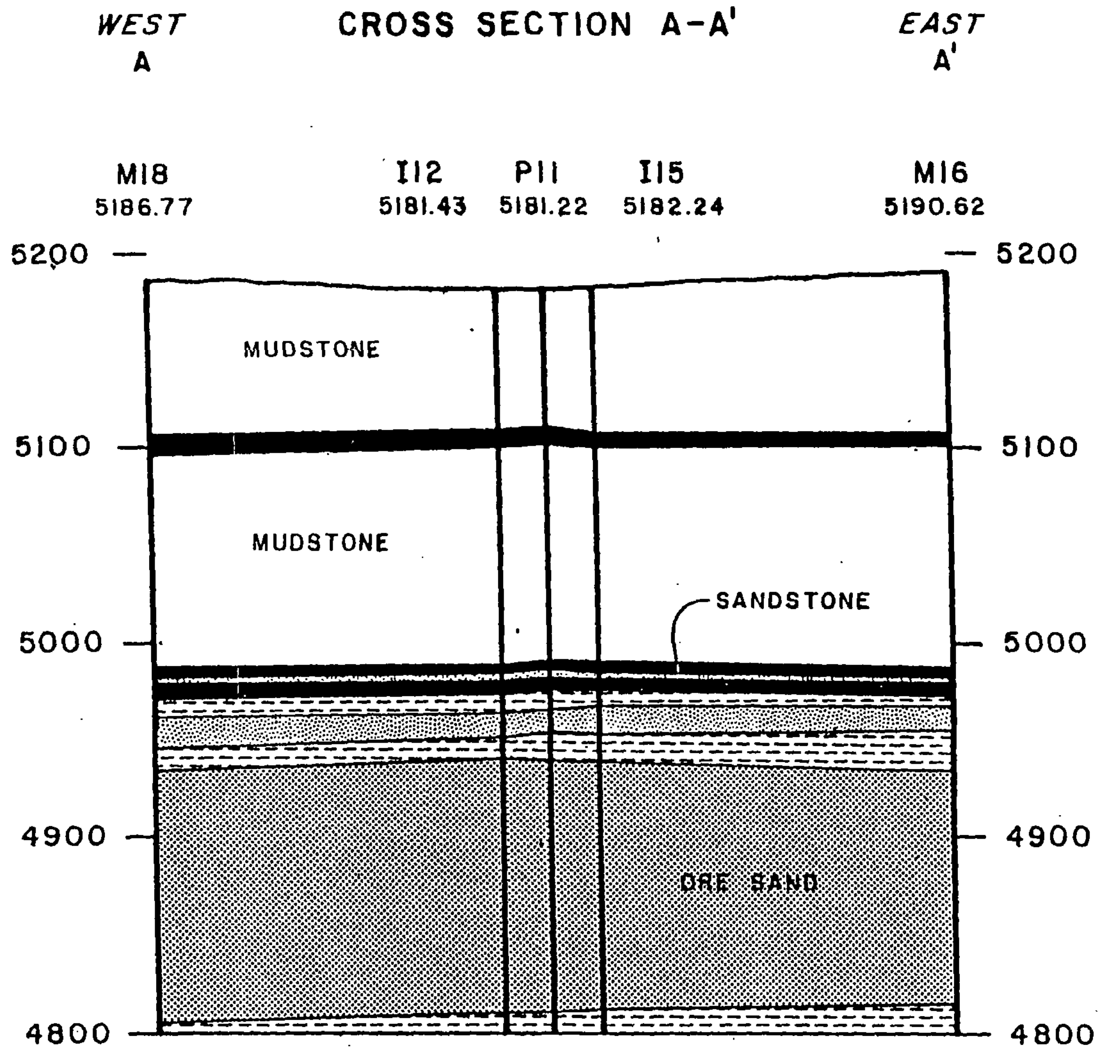
ROCKY MOUNTAIN ENERGY COMPANY

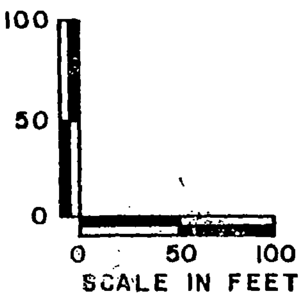
RENO CREEK-PATTERN 2

WELL LOCATIONS AND INDICATED CROSS SECTIONS

DATE JUNE, 1981	DRAWN: JNJ	FIGURE 2	REV.

027-02-6-076





LEGEND

- COAL
- MUDSTONE
- ORE SAND
- SANDSTONE
- SHALE

ROCKY MOUNTAIN ENERGY COMPANY

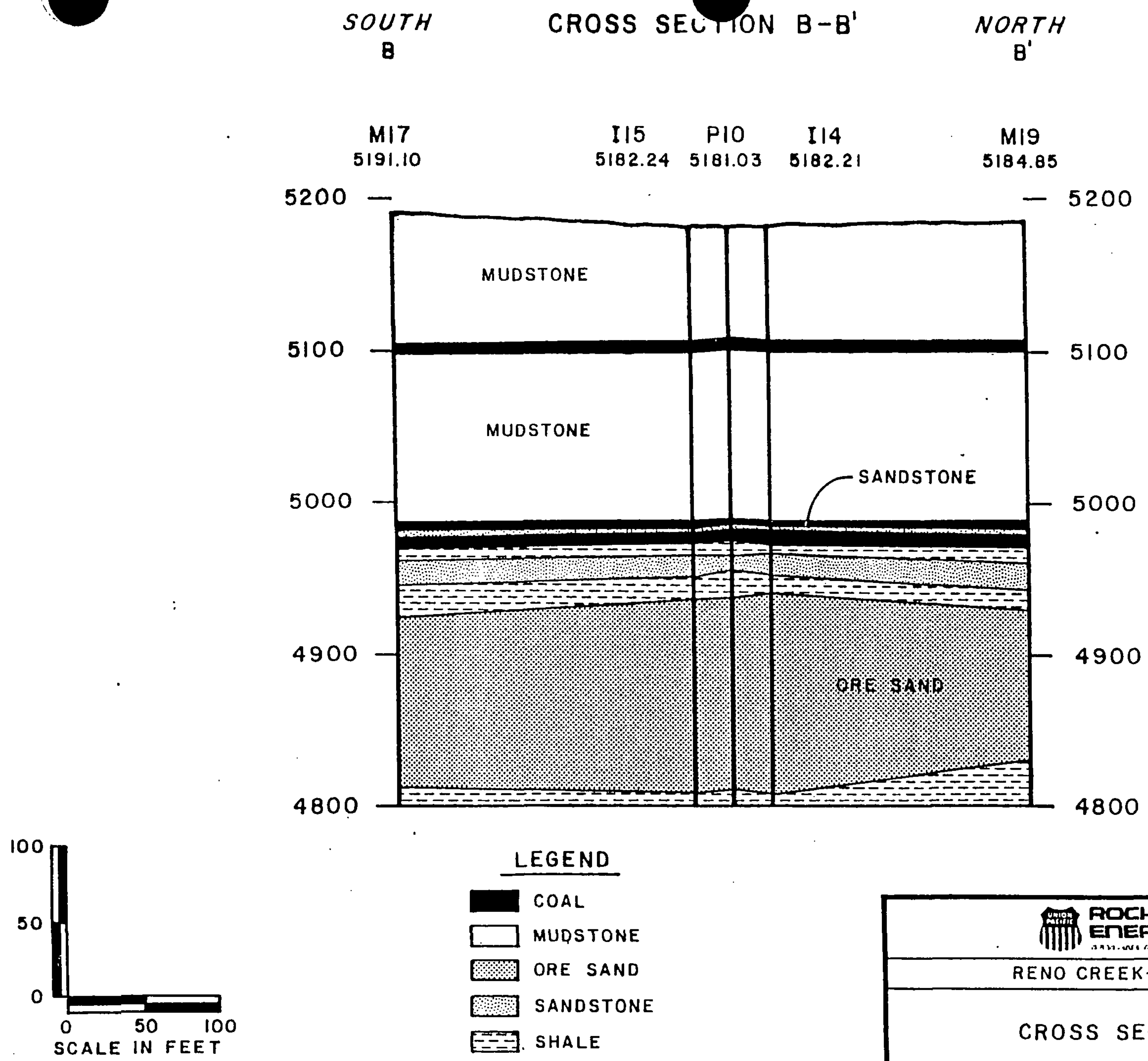
RENO CREEK-PATTERN 2

REV.

CROSS SECTION A-A'

DATE: JUNE,1981 | DRAWN BY: JNJ | FIGURE

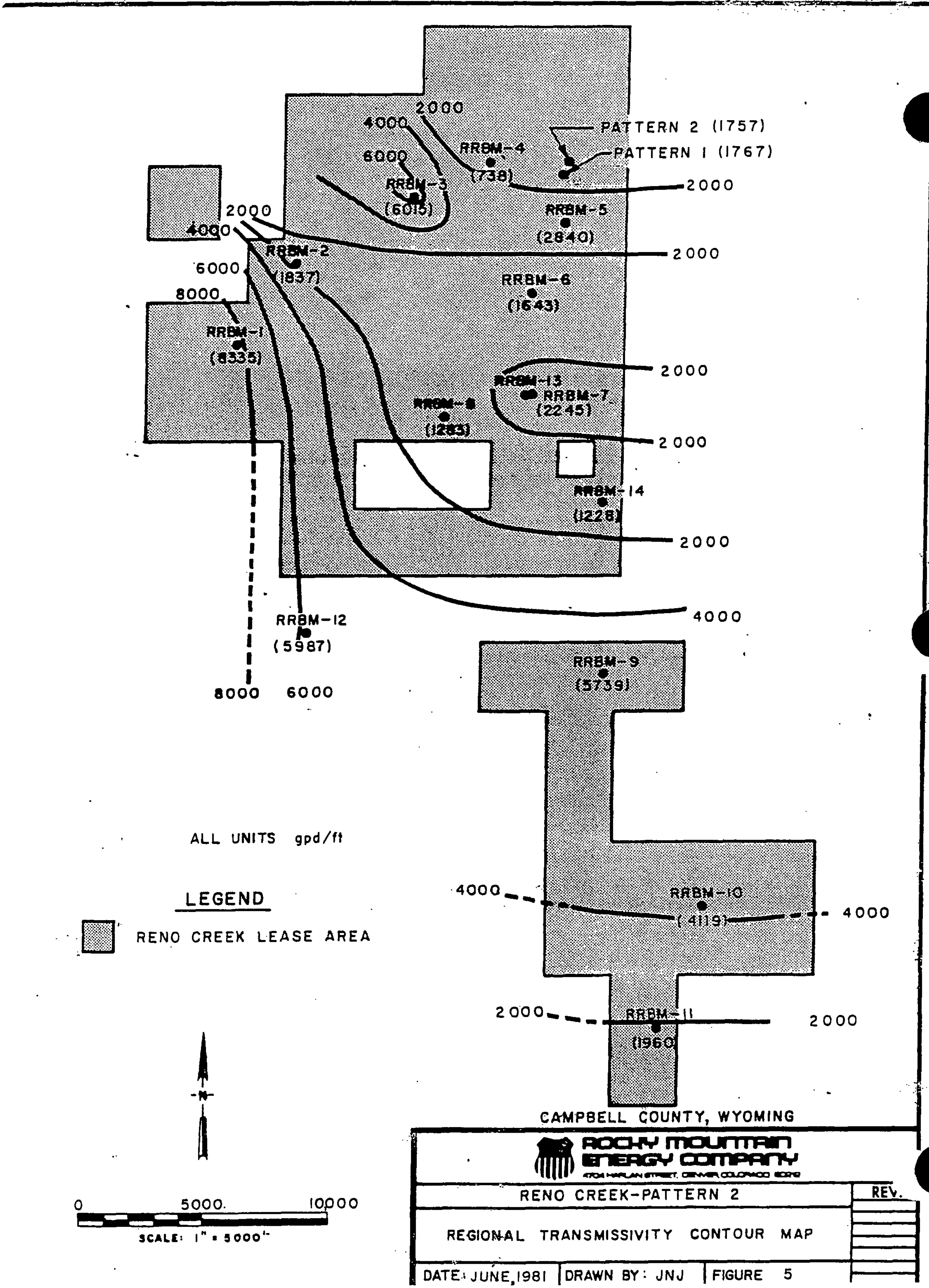
027-02-G-076

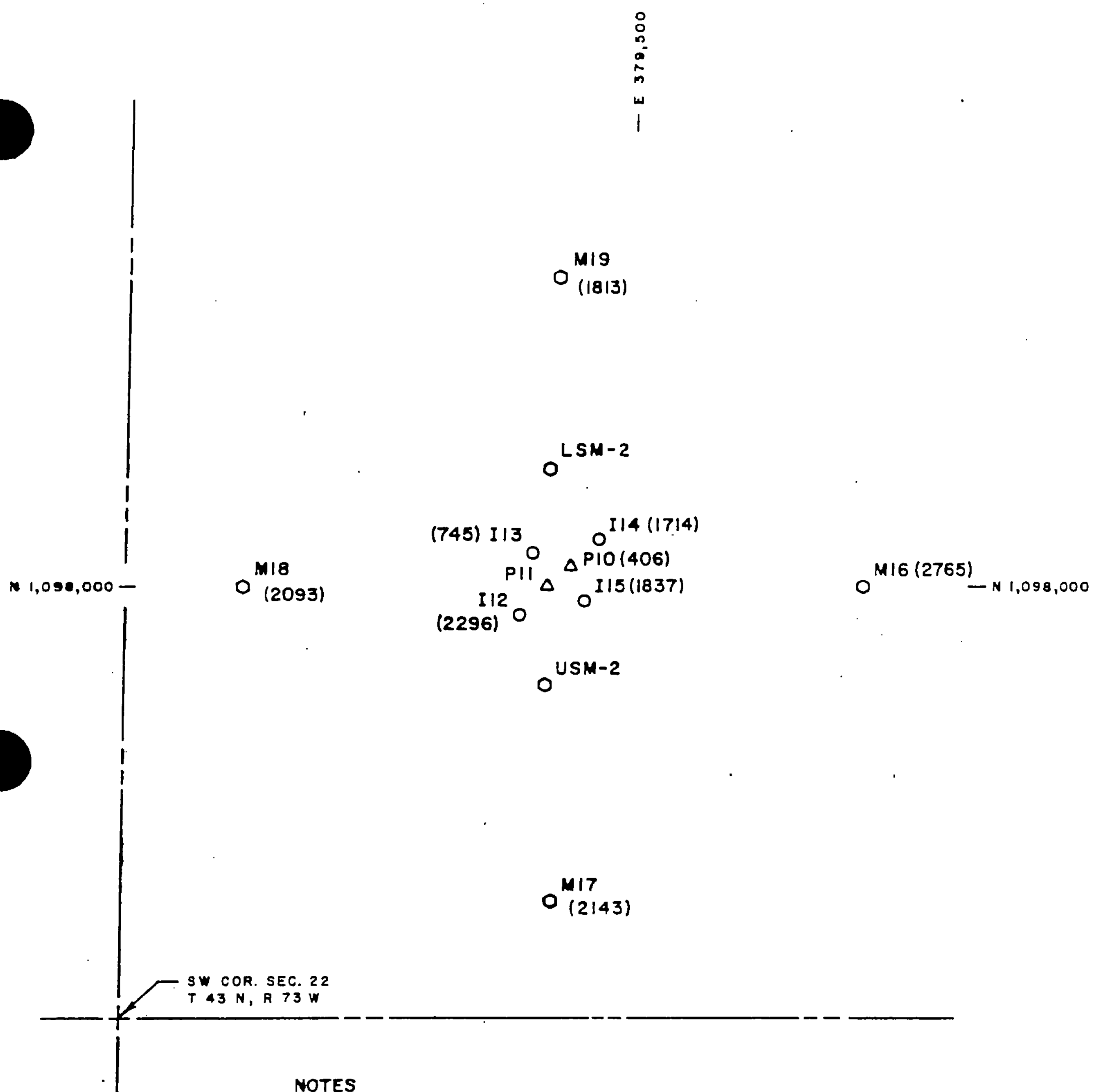


ROCKY MOUNTAIN ENERGY COMPANY

RENO CREEK-PATTERN 2			REV.
CROSS SECTION B-B'			
DATE: JUNE,1981	DRAWN BY: JNJ	FIGURE 4	

027-02-G-0.


2000
4000
6000
PATTERN 2 (1757)
PATTERN 1 (1767)
RRBM-4
(738)
RRBM-3
(6015)
2000
2000
4000
RRBM-5
(2840)
RRBM-2
(1837)
2000
6000
8000
RRBM-6
(1643)
RRBM-1
(8335)
2000
RRBM-13
RRBM-7
(2245)
RRBM-8
(1283)
2000
RRBM-14
(1228)
2000
4000
RRBM-12
(5987)
8000
6000
RRBM-9
(5739)
ALL UNITS gpd/ft
LEGEND
RENO CREEK LEASE AREA
4000
RRBM-10
(4119)
4000
2000
RRBM-11
(1960)
2000
N
0
5000
10000
SCALE: 1" = 5000'
CAMPBELL COUNTY, WYOMING
ROCKY MOUNTAIN ENERGY COMPANY
RENO CREEK-PATTERN 2
REV.
REGIONAL TRANSMISSIVITY CONTOUR MAP
DATE: JUNE, 1981
DRAWN BY: JNJ
FIGURE 5

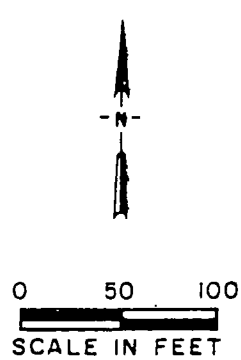


NOTES

1. ALL UNITS gpd/ft
2. ALL VALUES CALCULATED FROM PUMPING TEST

LEGEND

△ PRODUCTION WELL
○ INJECTION WELL
○ MONITOR WELL



CAMPBELL COUNTY, WYOMING

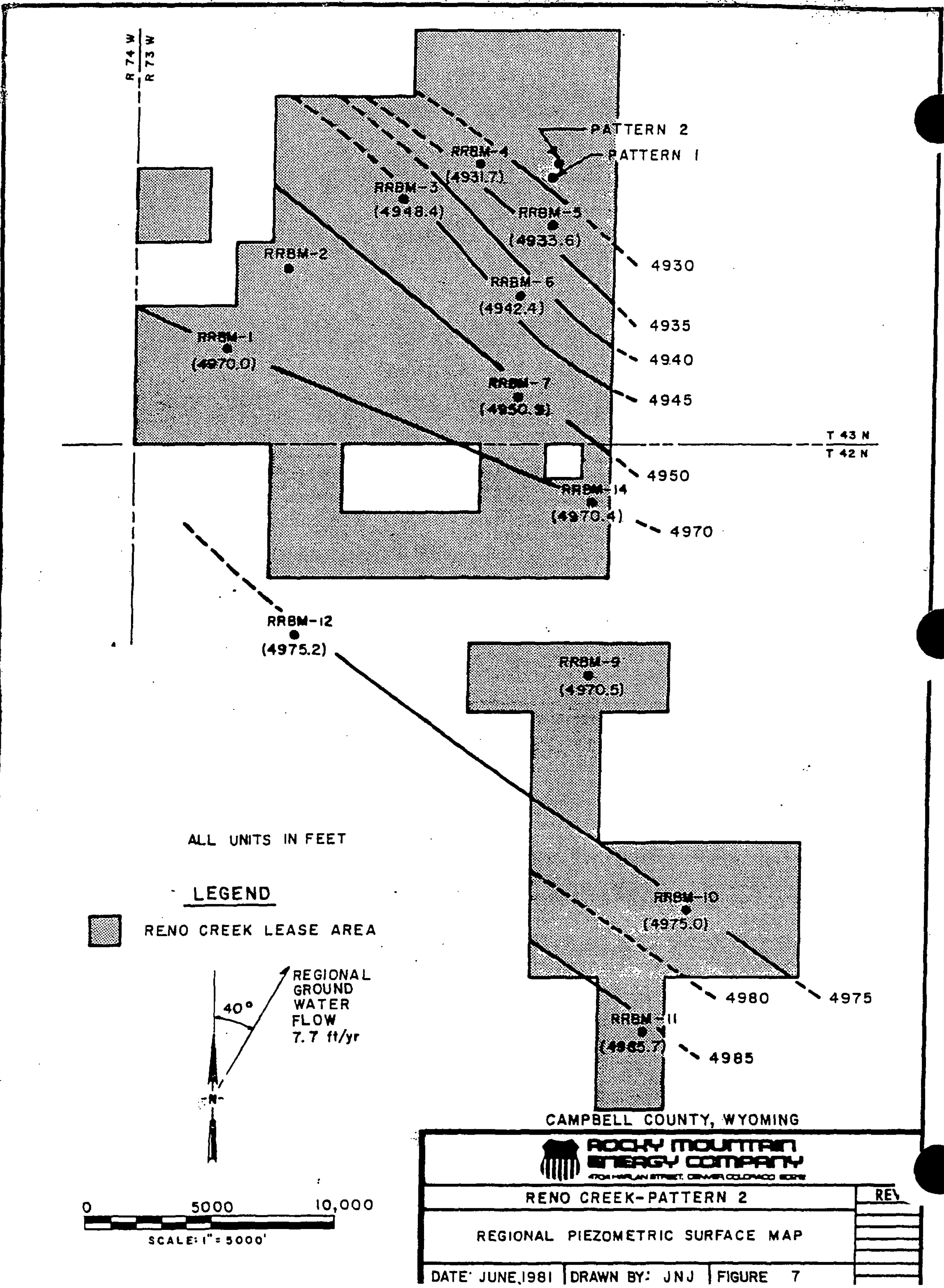
ROCKY MOUNTAIN ENERGY COMPANY

RENO CREEK—PATTERN 2

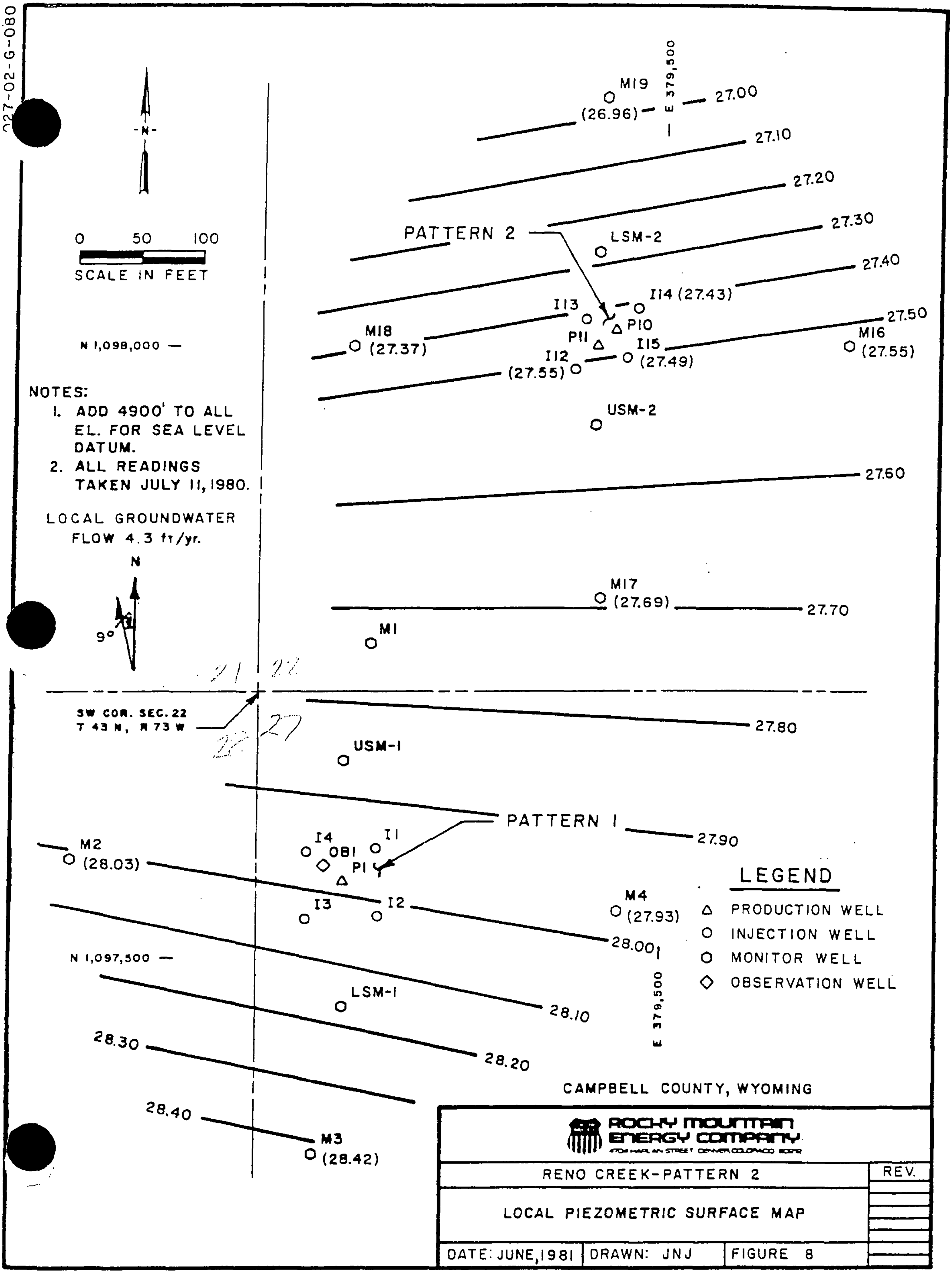
TRANSMISSIVITY DATA

DATE: JUNE, 1981	DRAWN: JNJ	FIGURE 6	REV. 6/24/81

027-02-G-078

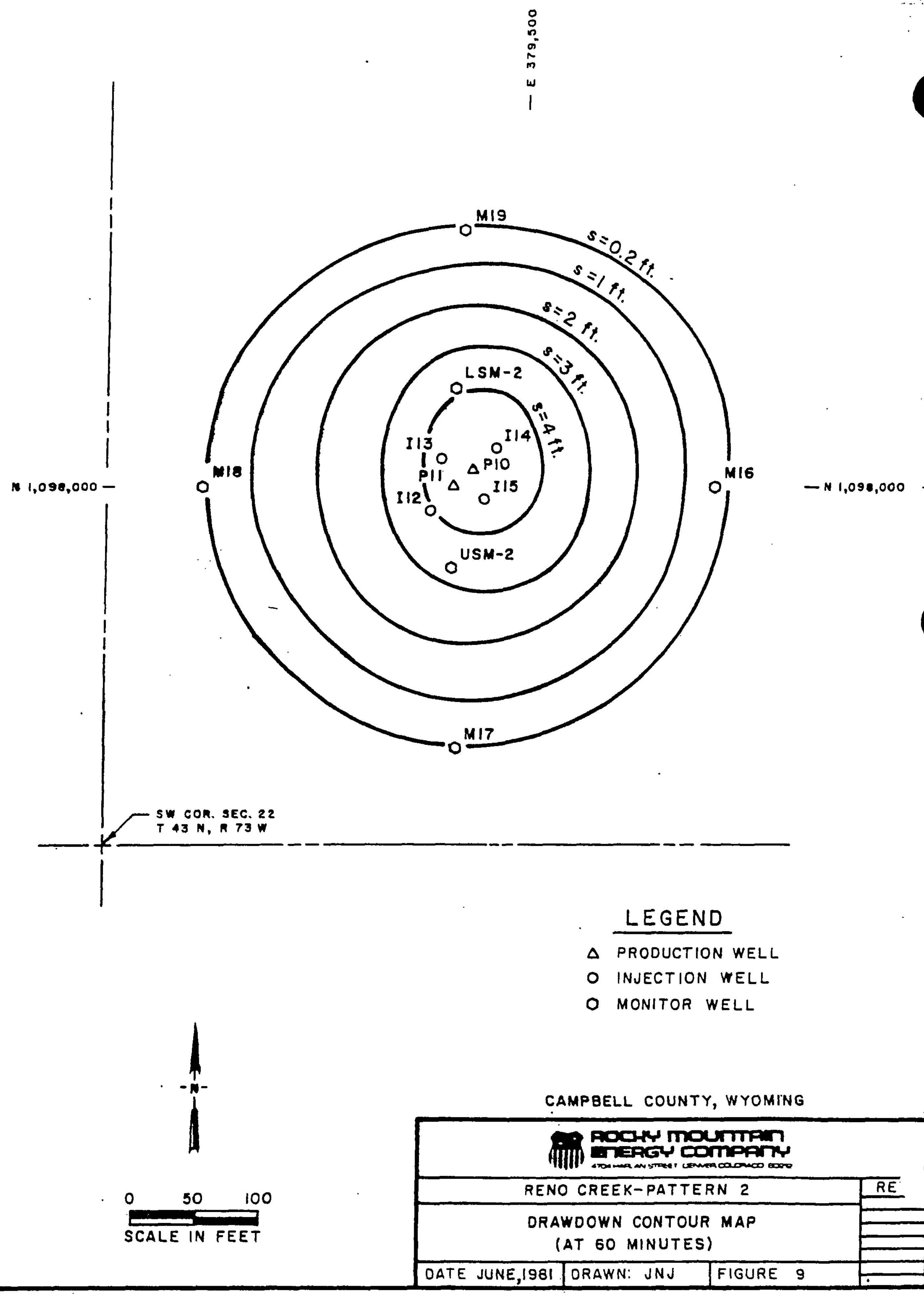

R 74 W
R 73 W
T 43 N
T 42 N
PATTERN 2
PATTERN 1
RRBM-1
(4970.0)
RRBM-2
RRBM-3
(4948.4)
RRBM-4
(4931.7)
RRBM-5
(4933.6)
RRBM-6
(4942.4)
RRBM-7
(4950.9)
RRBM-9
(4970.5)
RRBM-10
(4975.0)
RRBM-11
(4985.7)
RRBM-12
(4975.2)
RRBM-14
(4970.4)
4930
4935
4940
4945
4950
4970
4975
4980
4985
ALL UNITS IN FEET
LEGEND
RENO CREEK LEASE AREA
REGIONAL GROUND WATER FLOW 7.7 ft/yr
40°
N
0
5000
10,000
SCALE: 1" = 5000'
CAMPBELL COUNTY, WYOMING
ROCKY MOUNTAIN ENERGY COMPANY
RENO CREEK-PATTERN 2
REV
REGIONAL PIEZOMETRIC SURFACE MAP
DATE: JUNE, 1981
DRAWN BY: JNJ
FIGURE 7

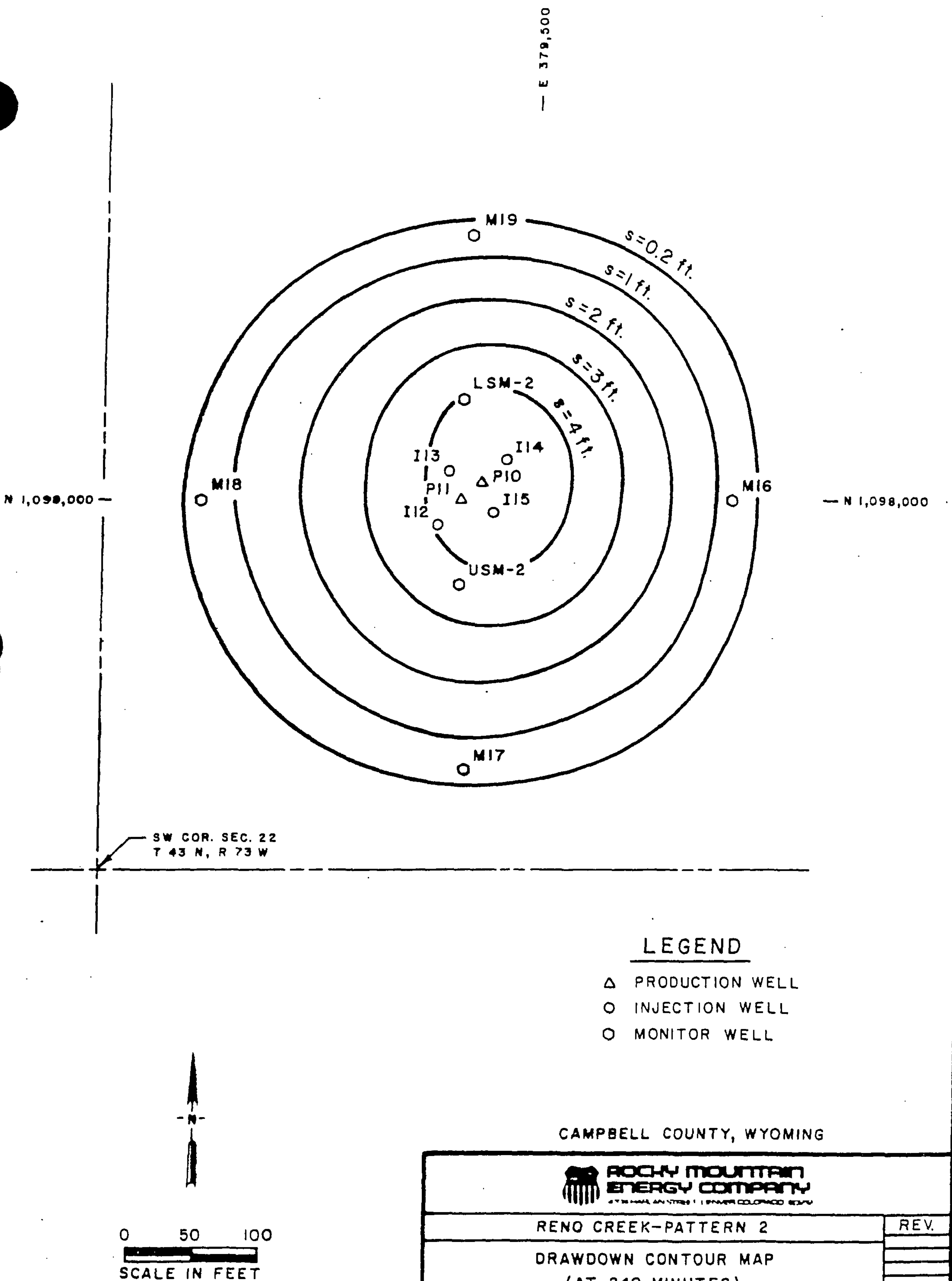
227-02-G-080



-N-
0 50 100
SCALE IN FEET
N 1,098,000
N 1,097,500
E 379,500
NOTES:
1. ADD 4900' TO ALL EL. FOR SEA LEVEL DATUM.
2. ALL READINGS TAKEN JULY 11, 1980.
LOCAL GROUNDWATER FLOW 4.3 ft/yr.
N
9°
SW COR. SEC. 22 T 43 N, R 73 W
21 22
28 27
PATTERN 2
PATTERN 1
M19 (26.96)
27.00
27.10
27.20
27.30
27.40
27.50
27.60
27.70
27.80
27.90
28.00
28.10
28.20
28.30
28.40
LSM-2
I13
I14 (27.43)
P10
P11
I12 (27.55)
I15 (27.49)
M18 (27.37)
M16 (27.55)
USM-2
M17 (27.69)
M1
USM-1
I4
I1
OB1
P1
I3
I2
M2 (28.03)
M4 (27.93)
LSM-1
M3 (28.42)
LEGEND
PRODUCTION WELL
INJECTION WELL
MONITOR WELL
OBSERVATION WELL
CAMPBELL COUNTY, WYOMING
ROCKY MOUNTAIN ENERGY COMPANY
RENO CREEK-PATTERN 2
REV.
LOCAL PIEZOMETRIC SURFACE MAP
DATE: JUNE, 1981
DRAWN: JNJ
FIGURE 8

G07-02-G-083

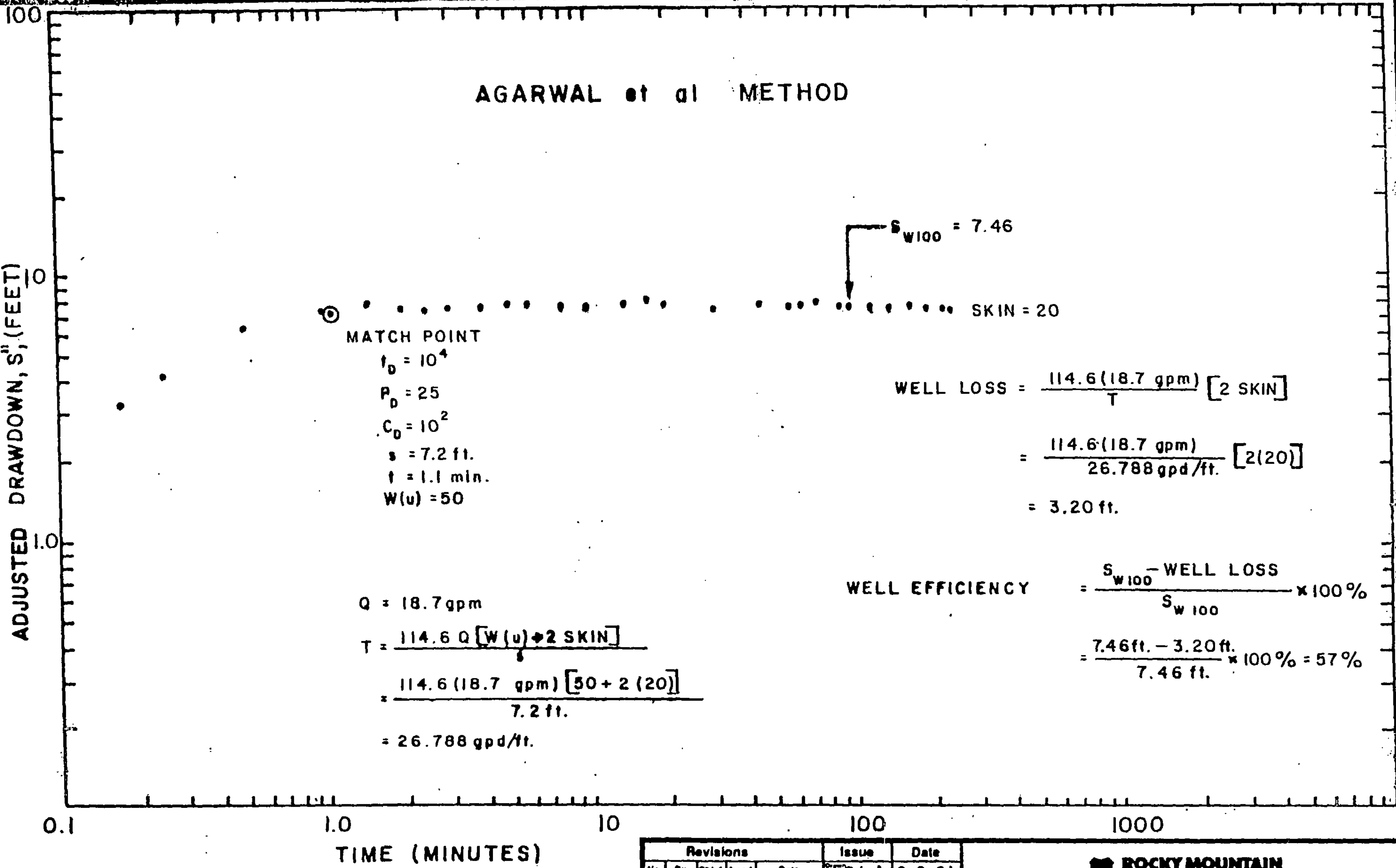

E 379,500
N 1,098,000
N 1,098,000
M19
M18
M16
M17
s=0.2 ft.
s=1 ft.
s=2 ft.
s=3 ft.
s=4 ft.
LSM-2
USM-2
I13
I14
P10
P11
I15
I12
SW COR. SEC. 22
T 43 N, R 73 W
LEGEND
PRODUCTION WELL
INJECTION WELL
MONITOR WELL
N
0 50 100
SCALE IN FEET
CAMPBELL COUNTY, WYOMING
ROCKY MOUNTAIN ENERGY COMPANY
RENO CREEK-PATTERN 2
RE
DRAWDOWN CONTOUR MAP
(AT 60 MINUTES)
DATE JUNE,1981
DRAWN: JNJ
FIGURE 9



CAMPBELL COUNTY, WYOMING

ROCKY MOUNTAIN ENERGY COMPANY

RENO CREEK–PATTERN 2	REV.
DRAWDOWN CONTOUR MAP (AT 240 MINUTES)	
DATE: JUNE, 1981 · DRAWN: JNJ · FIGURE 10	



DATA TAKEN MAY 29, 1980

Revisions					Issue	Date
No	By	Chkd	Appd	Date		
A	VS			6/25/81	Drawn S.L.A.	6-8-81
					Checked [illegible]	6/10/81
					Approved [illegible]	6/10/81
					Approved [illegible]	6-10-81
					Approved	
					Approved	

ROCKY MOUNTAIN ENERGY

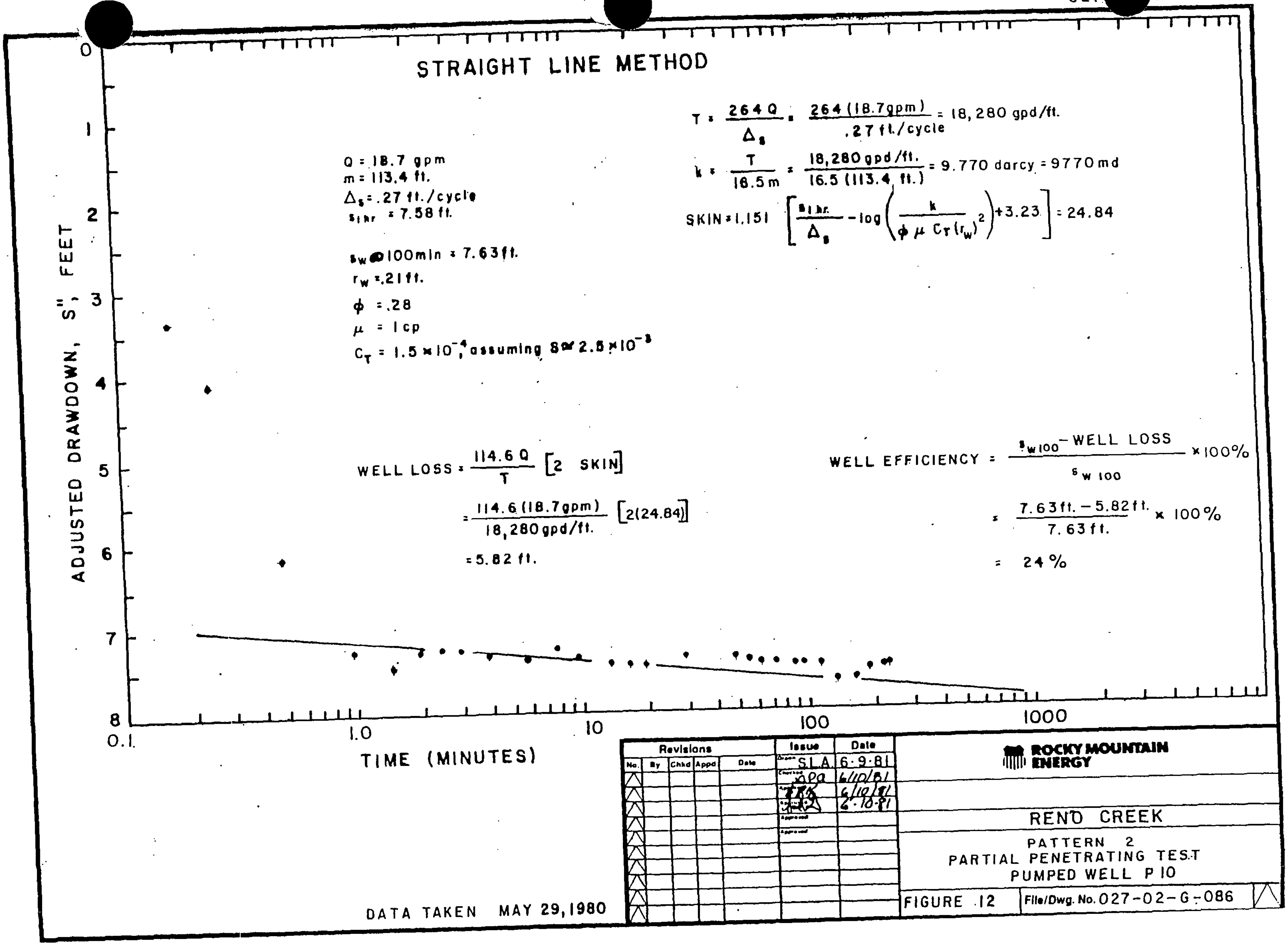
RENO CREEK

PATTERN 2

PARTIAL PENETRATING TEST

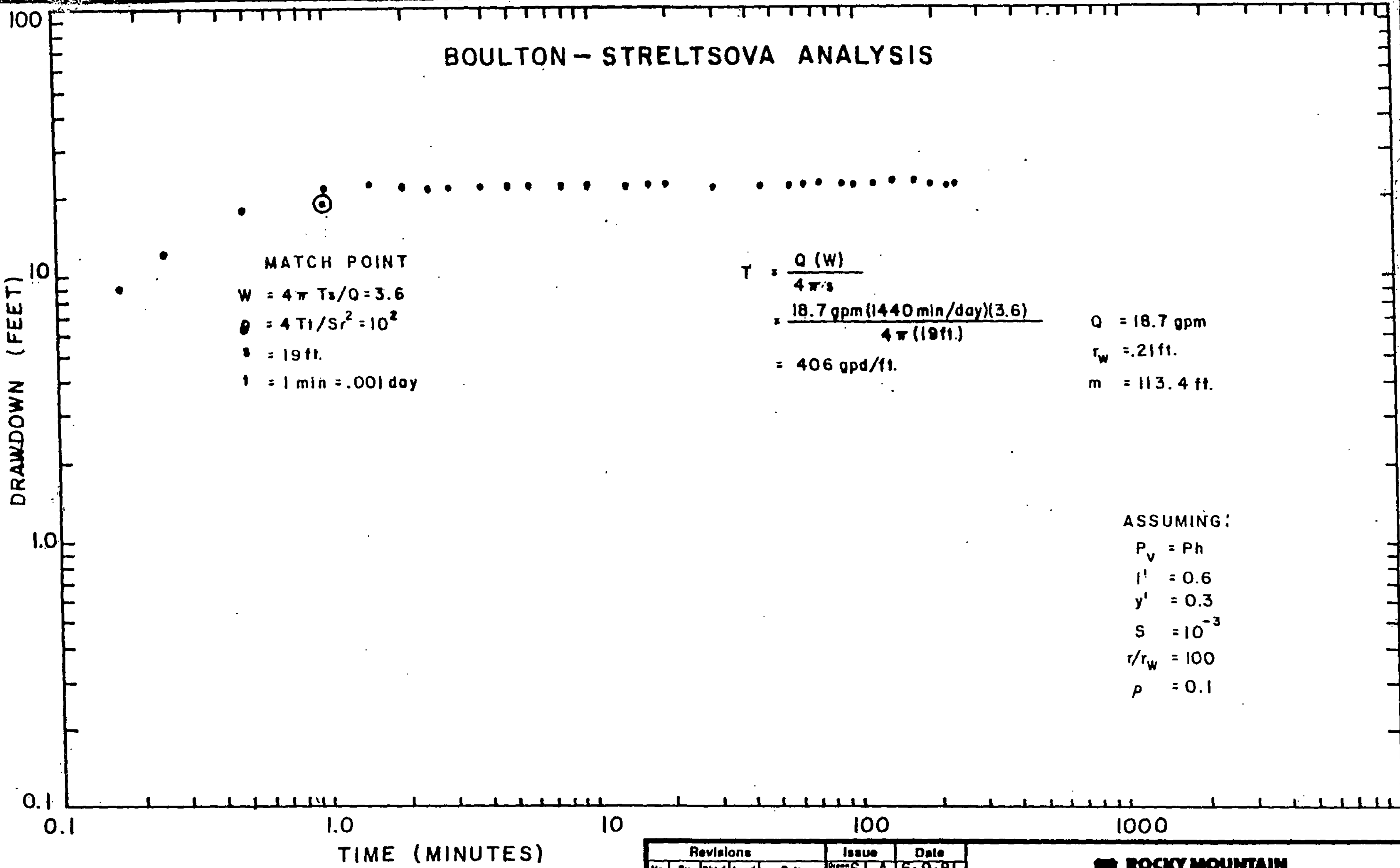
PUMPED WELL P 10

FIGURE 11 | File/Dwg. No. 027· -085 | A



STRAIGHT LINE METHOD
Q = 18.7 gpm
m = 113.4 ft.
Δs = .27 ft./cycle
s1hr = 7.58 ft.
sw @ 100 min = 7.63 ft.
rw = .21 ft.
φ = .28
μ = 1 cp
CT = 1.5 × 10^-4, assuming S ≈ 2.5 × 10^-3
T = 264 Q / Δs = 264 (18.7 gpm) / .27 ft./cycle = 18,280 gpd/ft.
k = T / 16.5 m = 18,280 gpd/ft. / 16.5 (113.4 ft.) = 9.770 darcy = 9770 md
SKIN = 1.151 [s1hr / Δs − log (k / φ μ CT (rw)^2) + 3.23] = 24.84
WELL LOSS = 114.6 Q / T [2 SKIN]
= 114.6 (18.7 gpm) / 18,280 gpd/ft. [2(24.84)]
= 5.82 ft.
WELL EFFICIENCY = (sw100 − WELL LOSS) / sw100 × 100%
= (7.63 ft. − 5.82 ft.) / 7.63 ft. × 100%
= 24 %
ADJUSTED DRAWDOWN, S", FEET
0
1
2
3
4
5
6
7
8
0.1
1.0
10
100
1000
TIME (MINUTES)
DATA TAKEN MAY 29, 1980
Revisions
No.
By
Chkd
Appd
Date
Issue
Date
Drawn SLA 6·9·81
Checked 6/10/81
6/10/81
6·10·81
Approved
ROCKY MOUNTAIN ENERGY
RENO CREEK
PATTERN 2
PARTIAL PENETRATING TEST
PUMPED WELL P 10
FIGURE 12
File/Dwg. No. 027-02-G-086

BOULTON – STRELTSOVA ANALYSIS



DATA TAKEN MAY 29, 1980

Revisions					Issue	Date
No.	By	Chkd.	Appd.	Date		
					Drawn SLA	6-9-81
					Checked DPO	6/10/81
					Approved RPK	6/10/81
					Approved [illegible]	6-10-81
					Approved	
					Approved	

ROCKY MOUNTAIN ENERGY

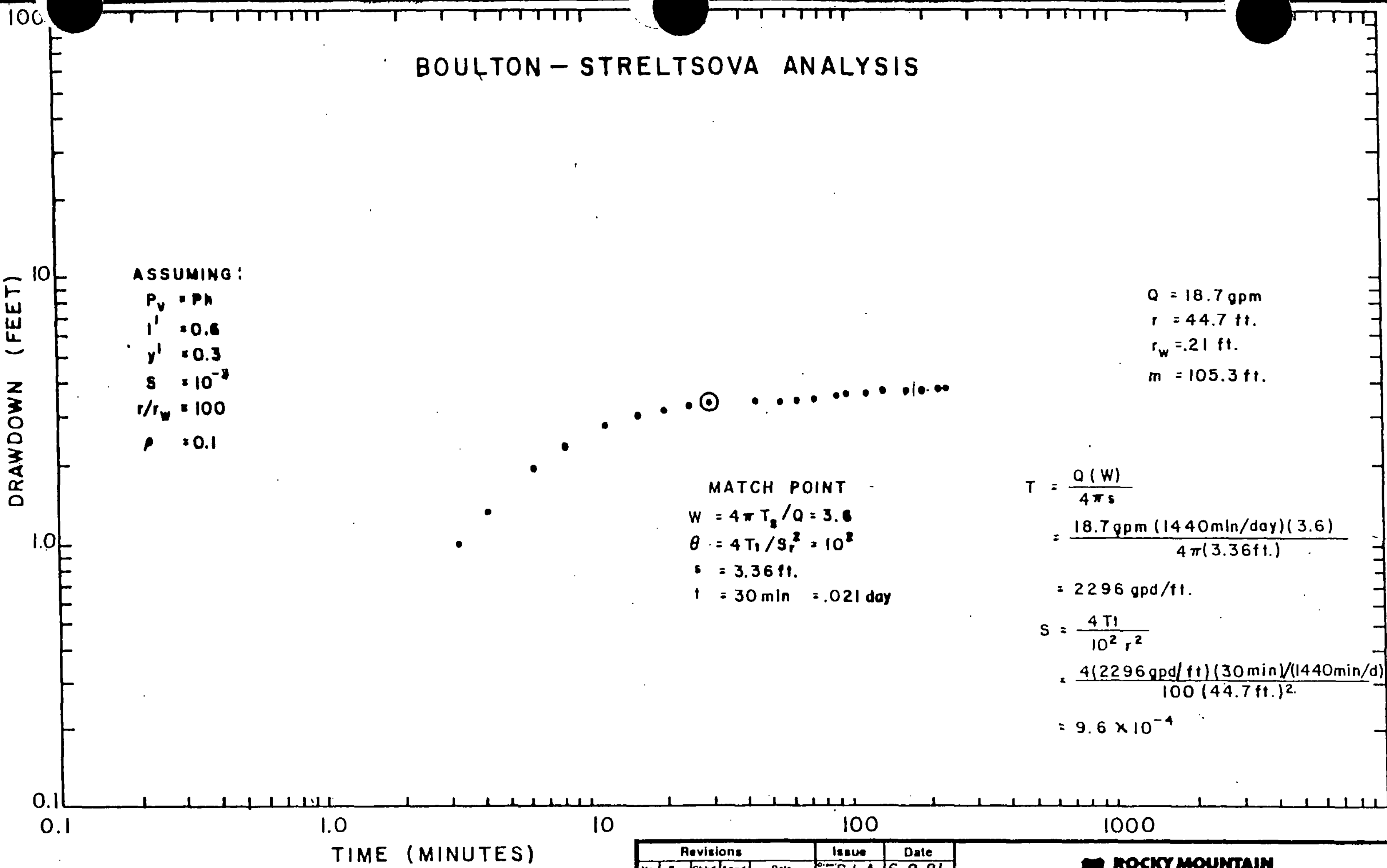
RENO CREEK

PATTERN 2

PARTIAL PENETRATING TEST

PUMPED WELL P 10

FIGURE 13 | File/Dwg. No. 027 -087



DATA TAKEN MAY 29, 1980

Revisions					Issue	Date
No	By	Chkd	Appd	Date	SLA	6·9·81
					[illegible]	6/10/81
					[illegible]	6/10/81
					[illegible]	6·10·81

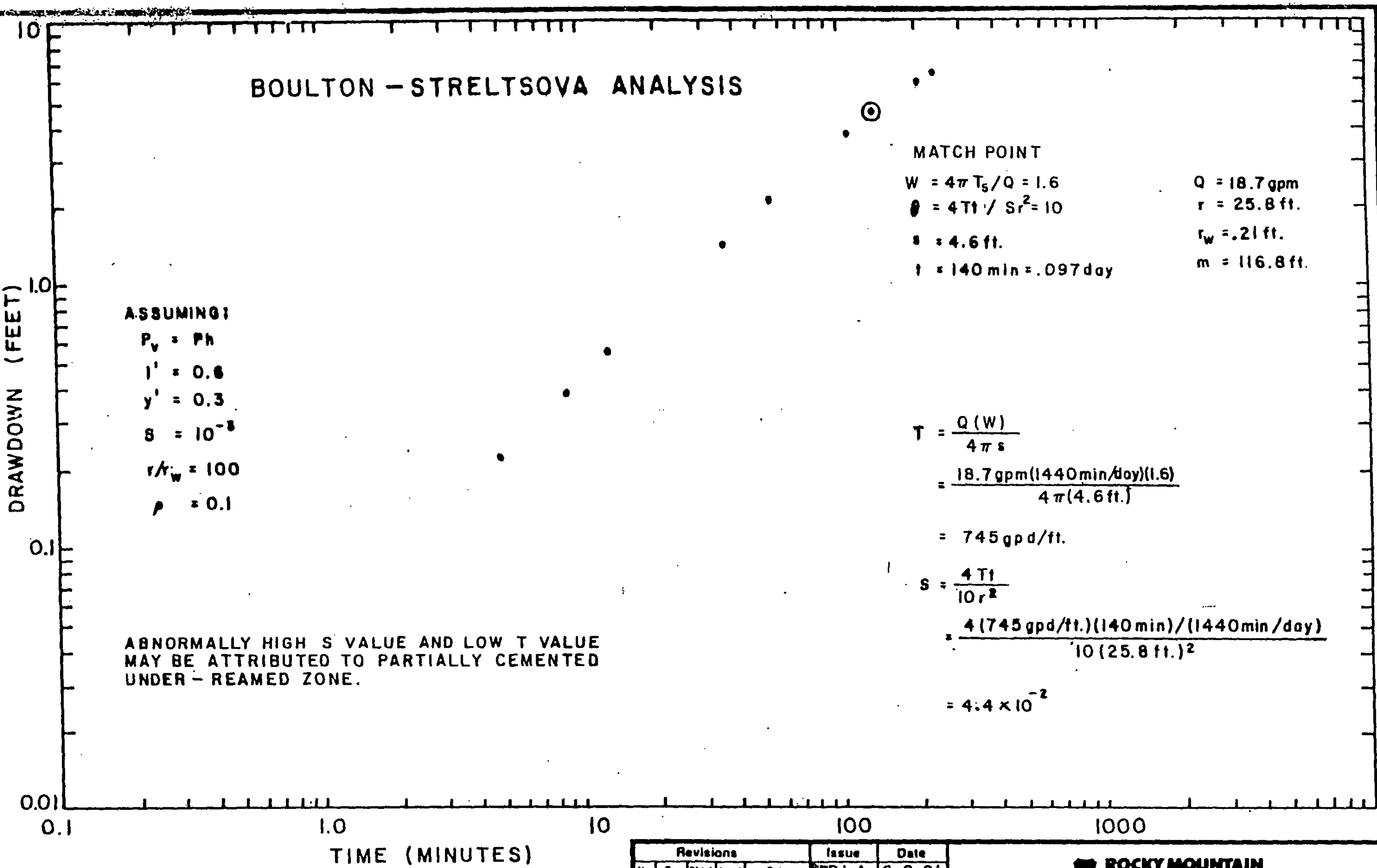
ROCKY MOUNTAIN ENERGY

RENO CREEK

PATTERN 2
PARTIAL PENETRATING WELL
OBSERVATION WELL I 12

FIGURE 14 | File Dwg. No. 027-02-G-088

BOULTON – STRELTSOVA ANALYSIS



MATCH POINT

$W = 4\pi T_s/Q = 1.6$

$\theta = 4Tt / Sr^2 = 10$

$s = 4.6$ ft.

$t = 140$ min $= .097$ day

Q = 18.7 gpm

r = 25.8 ft.

$r_w = .21$ ft.

m = 116.8 ft.

ASSUMING:

$P_v = Ph$

$l' = 0.6$

$y' = 0.3$

$S = 10^{-3}$

$r/r_w = 100$

$\rho = 0.1$

$$T = \frac{Q(W)}{4\pi s}$$

$$= \frac{18.7 \text{ gpm}(1440 \text{ min/day})(1.6)}{4\pi(4.6 \text{ ft.})}$$

$$= 745 \text{ gpd/ft.}$$

$$S = \frac{4Tt}{10r^2}$$

$$= \frac{4(745 \text{ gpd/ft.})(140 \text{ min})/(1440 \text{ min/day})}{10(25.8 \text{ ft.})^2}$$

$$= 4.4 \times 10^{-2}$$

ABNORMALLY HIGH S VALUE AND LOW T VALUE MAY BE ATTRIBUTED TO PARTIALLY CEMENTED UNDER – REAMED ZONE.

DATA TAKEN MAY 29, 1980

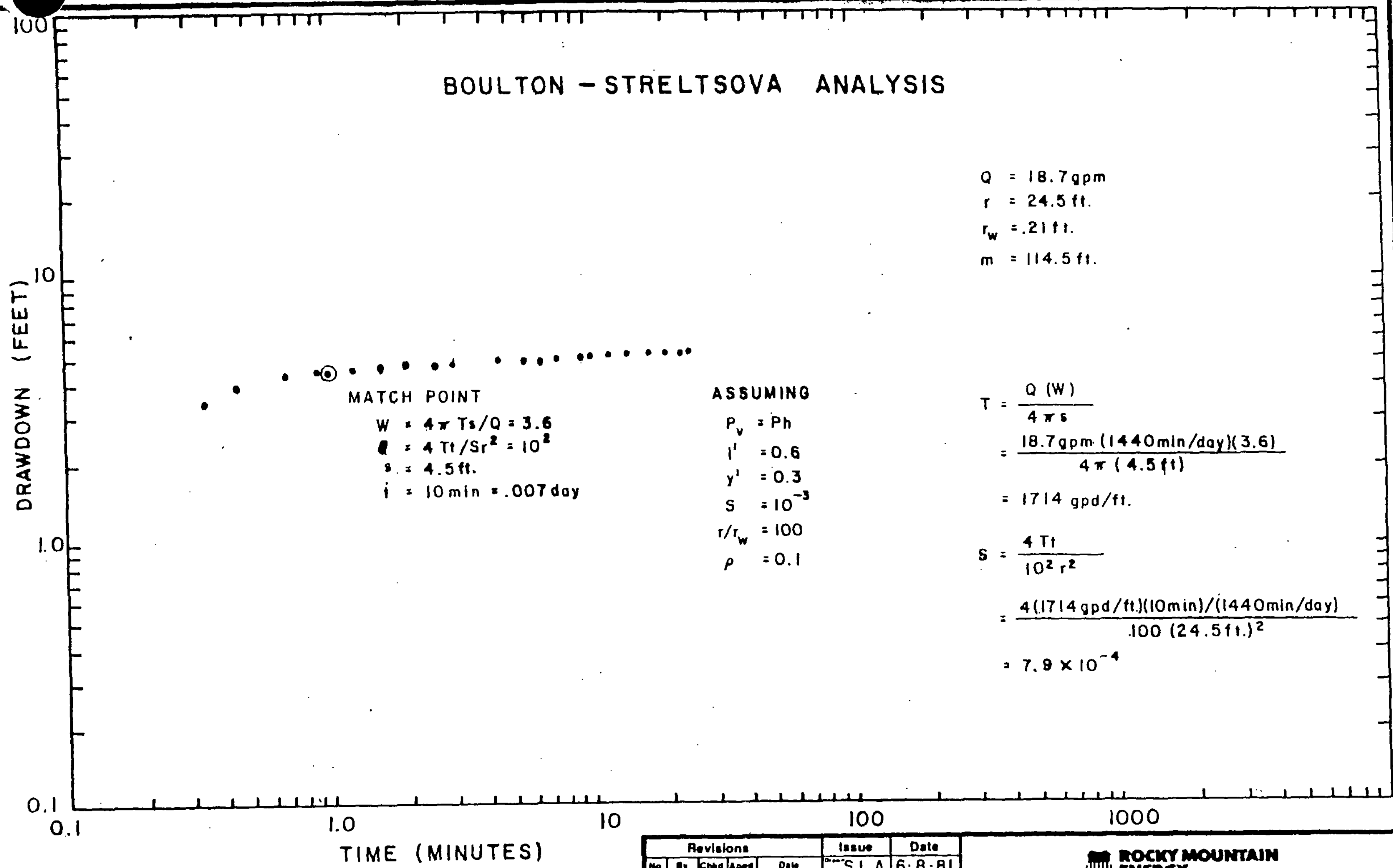
Revisions					Issue	Date
No.	By	Chkd	Appd	Date		
					S.L.A.	6·9·81
					[illegible]	6/10/81
					[illegible]	6/10/81
					[illegible]	6·10·81

ROCKY MOUNTAIN ENERGY

RENO CREEK

PATTERN 2
PARTIAL PENETRATING TEST
OBSERVATION WELL I13

FIGURE 15 | File Dwg. No. 027-02-[illegible]89



DATA TAKEN MAY 29, 1980

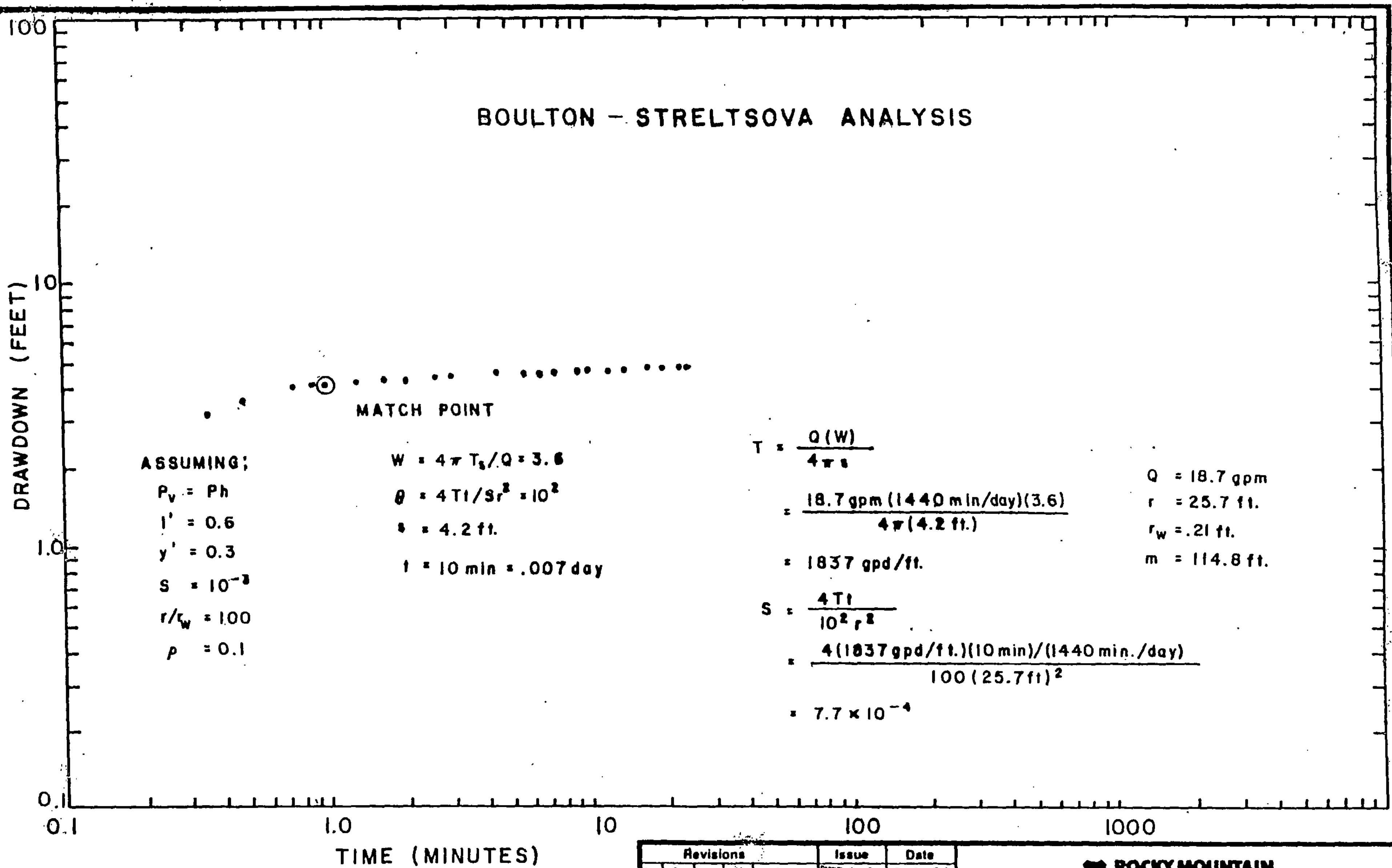
Revisions					Issue	Date
No	By	Chkd	Appd	Date	Drawn SLA	6-8-81
					Checked [illegible]	6/10/81
					Approved BPK	6/10/81
					Approved [illegible]	6-10-81
					Approved	
					Approved	

ROCKY MOUNTAIN ENERGY

RENO CREEK

PATTERN 2
PARTIAL PENETRATING TEST
OBSERVATION WELL I 14

FIGURE [illegible]



DATA TAKEN MAY 29, 1980

Revisions					Issue	Date
No	By	Chkd	Appd	Date	Drawn S.L.A.	6-8-81
					Checked [illegible]	6/10/81
					Approved [illegible]	6/10/81
					Approved [illegible]	6-10-81

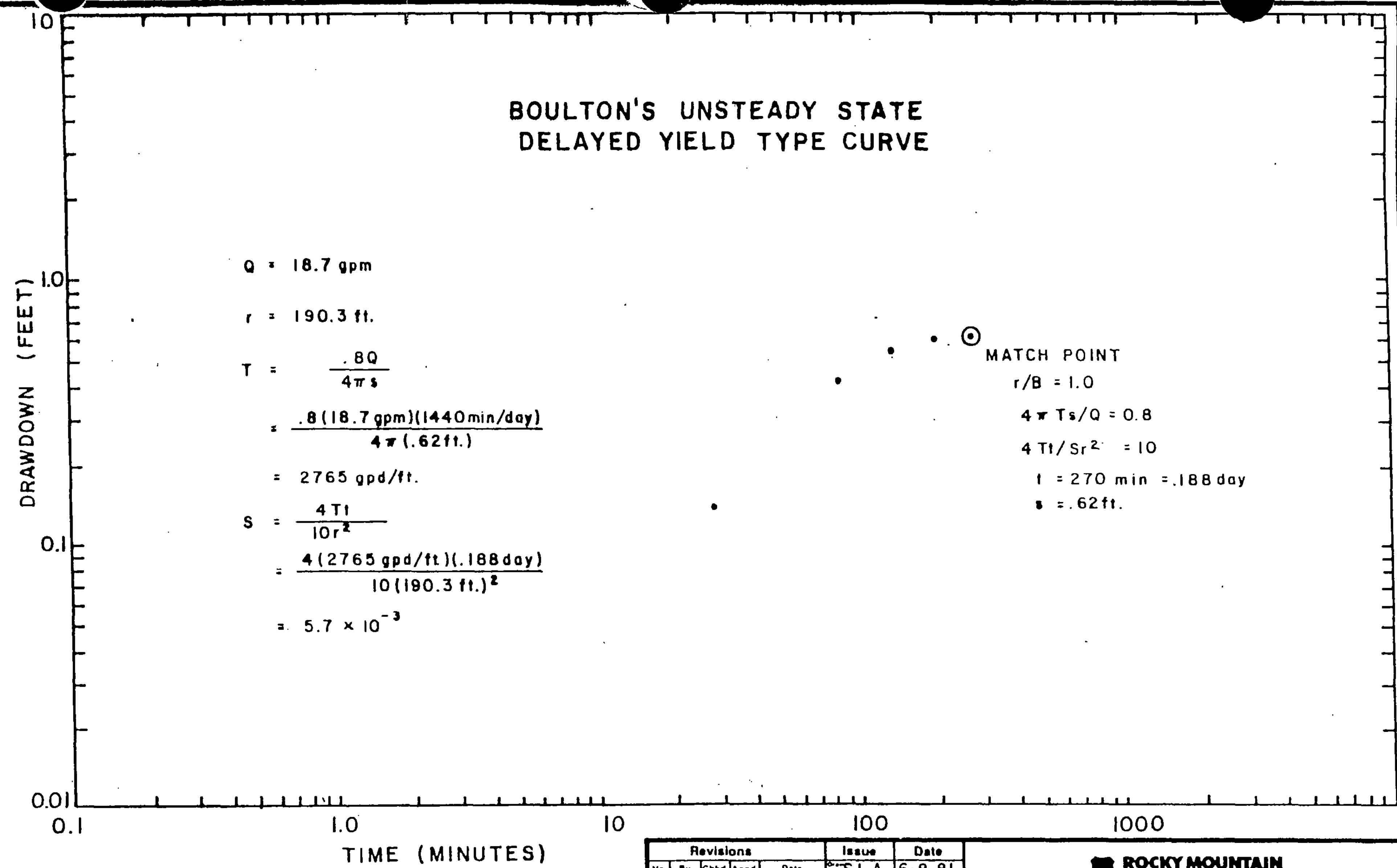
ROCKY MOUNTAIN ENERGY

RENO CREEK

PATTERN 2
PARTIAL PENETRATING TEST
OBSERVATION WELL I 15

FIGURE 17 | File/Dwg. No. 02[illegible]G-091

BOULTON'S UNSTEADY STATE DELAYED YIELD TYPE CURVE



Q = 18.7 gpm

r = 190.3 ft.

$$T = \frac{.8Q}{4\pi s}$$

$$= \frac{.8(18.7\ \text{gpm})(1440\ \text{min/day})}{4\pi(.62\ \text{ft.})}$$

= 2765 gpd/ft.

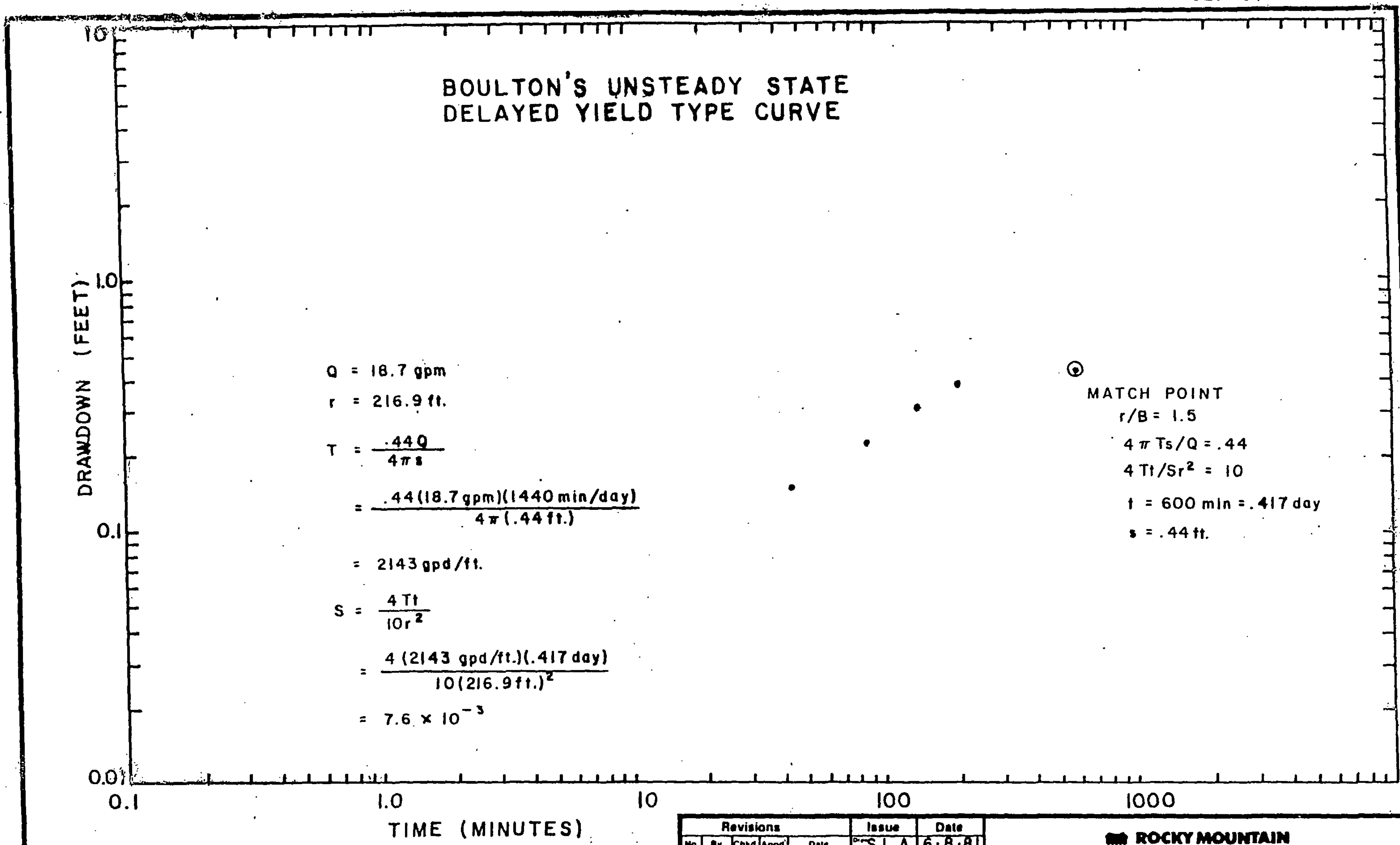
$$S = \frac{4Tt}{10r^2}$$

$$= \frac{4(2765\ \text{gpd/ft})(.188\ \text{day})}{10(190.3\ \text{ft.})^2}$$

$= 5.7 \times 10^{-3}$

DATA TAKEN MAY 29, 1980

Revisions					Issue	Date	
No.	By	Chkd	Appd	Date	Drawn S.L.A.	6-8-81	ROCKY MOUNTAIN ENERGY
					Checked [signature]	6/10/81	
					Approved [signature]	6/10/81	RENO CREEK
					Approved [signature]	6-10-81	PATTERN 2 FULLY PENETRATING TEST OBSERVATION WELL M16
					Approved		
							FIGURE 18 — File Dwg. No. 027-02-G-092



Q = 18.7 gpm

r = 216.9 ft.

$$T = \frac{.44Q}{4\pi s}$$

$$= \frac{.44(18.7\text{ gpm})(1440\text{ min/day})}{4\pi(.44\text{ ft.})}$$

= 2143 gpd/ft.

$$S = \frac{4Tt}{10r^2}$$

$$= \frac{4(2143\text{ gpd/ft.})(.417\text{ day})}{10(216.9\text{ ft.})^2}$$

$= 7.6 \times 10^{-3}$

DATA TAKEN MAY 29, 1980

Revisions					Issue	Date
No	By	Chkd	Appd	Date		
					Drawn S.L.A.	6·8·81
					Checked [illegible]	6/10/81
					Approved [illegible]	6/10/81
					Approved [illegible]	6-10-81

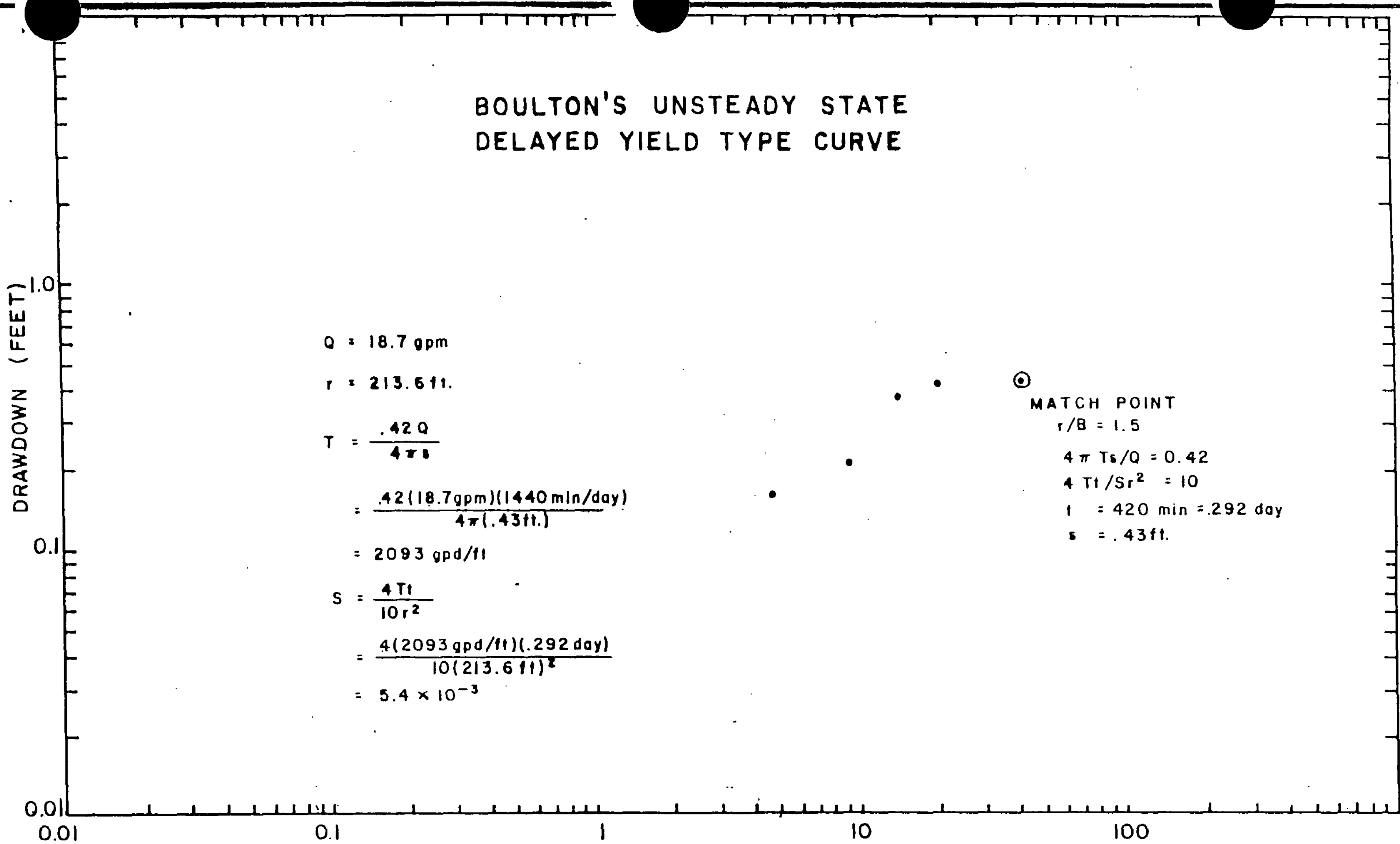
ROCKY MOUNTAIN ENERGY

RENO CREEK

PATTERN 2
FULLY PENETRATING TEST
OBSERVATION WELL M 17

FIGURE 19 | File/Dwg. No. 027-[illegible]G-093

BOULTON'S UNSTEADY STATE DELAYED YIELD TYPE CURVE



Q = 18.7 gpm

r = 213.6 ft.

$$T = \frac{.42\,Q}{4\pi s}$$

$$= \frac{.42(18.7\text{gpm})(1440\text{ min/day})}{4\pi(.43\text{ft.})}$$

$$= 2093 \text{ gpd/ft}$$

$$S = \frac{4Tt}{10r^2}$$

$$= \frac{4(2093\text{ gpd/ft})(.292\text{ day})}{10(213.6\text{ ft})^2}$$

$$= 5.4 \times 10^{-3}$$

DATA TAKEN MAY 29, 1980

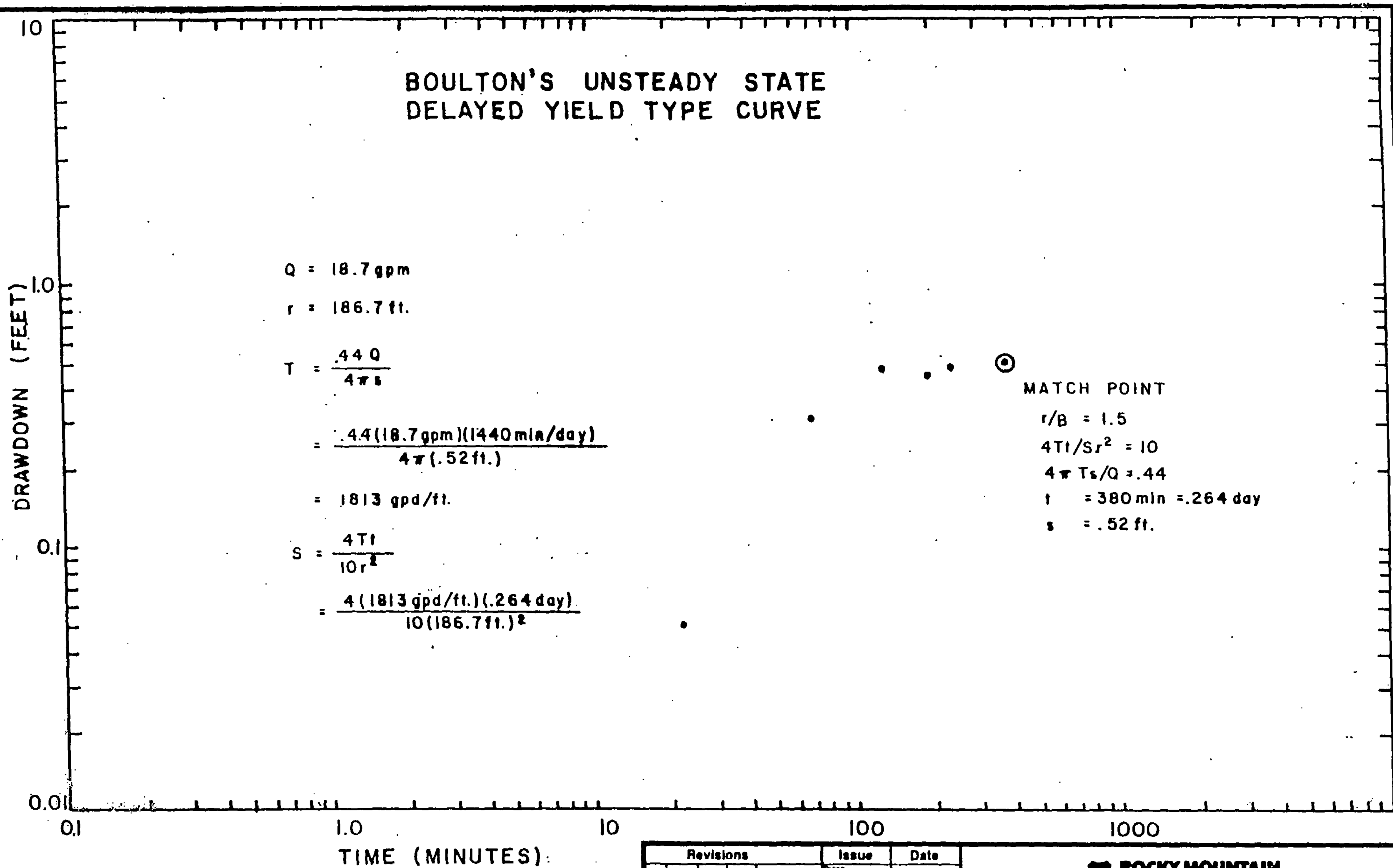
Revisions No.	By	Chkd	Appd	Date	Issue	Date
					Drawn SLA	6-8-81
					Checked [illegible]	6/10/81
					[illegible]	6/10/81
					[illegible]	6-10-81

ROCKY MOUNTAIN ENERGY

RENO CREEK

PATTERN 2
FULLY PENETRATING TEST
OBSERVATION WELL M 18

FIGURE 20 File/Dwg. No. 027-02-G-094



DATA TAKEN MAY 29, 1980

Revisions					Issue	Date
No.	By	Chkd.	Appd.	Date		
					Drawn SLA	6-8-81
					Checked	6/10/81
						6/10/81
						6-10-81
					Approved	

ROCKY MOUNTAIN ENERGY

RENO CREEK

PATTERN 2
FULLY PENETRATING TEST
OBSERVATION WELL RM 19

FIGURE 21 | File/Dwg. No. 0 G-095

FIELD DATA

ROCKY MOUNTAIN ENERGY COMPANY

AQUIFER TEST DATA SHEET ①

DATE 5·29·80 JOB DESCRIPTION Constant Rate, p. 1

LOCATION Reno Creek -- Pattern 2

WELL NO. P10 TYPE Pumped

COLLAR ELEVATION 1.4' T.C. above L.S.

TOTAL DEPTH FROM COLLAR 400' DIAMETER 5"

Under-Reamed 285-310' and 330-335' FT.

TRANSDUCER SERIAL NO. 40947 OFFSET 1.40

RANGE 100 SENSITIVITY 0.99

(TAPE DESCRIPTION) → Static W.L. above probe = 49.81

DATE	TIME hrs. min. sec.	MINUTES	BARO. READING (psi)	PRESSURE READING (psi)	Adjusted Drawdown 5'	Adjusted Drawdown 5"	DRAWDOWN (ft.)	FLOW RATE (gpm)
		0	4.20	18.56				
	8:47	0	4.21	18.58			0	
start	8:48	0.17		14.54	9.04'	3.33	-9.43	
		0.25		13.22	11.13	4.10	12.51	
		0.5		10.81	16.68	6.15	18.13	
		1.0		9.23	19.72	7.27	21.82	
		1.33	Flow begins					
		1.5		8.99	20.17	7.43	22.38	19.09
		2		9.19	19.79	7.29	21.91	
		2.5		9.24	19.69	7.26	21.79	
		3		9.22	19.74	7.28	21.84	
		4		9.13	19.91	7.34	22.05	
		5		9.05	20.06	7.39	22.24	19.49
		6	4.22	9.04	20.06	7.39	22.24	
		8		9.10	19.95	7.35	22.10	
		10		9.07	20.00	7.37	22.17	
		14	"	8.97	20.19	7.44	22.40	19.30
		17		8.94	20.24	7.46	22.47	19.05
		20	4.23	8.96	20.19	7.44	22.40	19.06
		30		9.07	19.98	7.36	22.14	18.93
		45	4.25	9.01	20.06	7.39	22.24	18.73
		58	"	8.97	20.13	7.42	22.33	18.78
		65	"	8.95	20.17	7.43	22.38	
		75	"	8.94	20.19	7.44	22.40	18.94
		91	4.25	8.91	20.24	7.46	22.47	18.80
		100	"	8.91	20.24	7.46	22.47	
		120	4.26	8.89	20.26	7.47	22.49	18.64
		140	"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

ROCKY MOUNTAIN ENERGY COMPANY

AQUIFER TEST DATA SHEET ①

DATE 5·29·80 JOB DESCRIPTION Constant Rate p. 2
LOCATION Reno Creek -- Pattern 2
WELL NO. P10 TYPE pumped
COLLAR ELEVATION
TOTAL DEPTH FROM COLLAR DIAMETER
SCREEN FROM FT. TO FT.
TRANSDUCER SERIAL NO. 40947 OFFSET
RANGE SENSITIVITY
(TAPE DESCRIPTION)

DATE	TIME hrs. min. sec.	MINUTES	BARO. READING (psi)	PRESSURE READING (psi)	Adjusted Drawdown S'	Adjusted Drawdown S''	DRAWDOWN (ft.)	FLOW RATE (gpm)
		170		8.64	20.73	7.64	23.08	
		195	4.27	8.81	20.40	7.52	22.66	18.64
		225	"	8.84	20.34	7.50	22.59	18.65
		240	4.28	8.84	20.32	7.49	22.56	

No Recovery done due to hose-leakage which refills the well

Adjusted Drawdown, $S' = S_w - S_w^2/2m$ $m = 113.4$ Ft → Sat. thickness

→ Unconfined Aquifer and using the Theis Graphical Solution

Adjusted Drawdown, $S'' = \frac{S_w \alpha}{C}$ where α = Fractional part of m tapped by the pumped well (.26)

and $1/C = 1 + 7(r_w/2\alpha m)^{1/2} \cos(\pi\alpha/2)$

→ Pumped Well tapping less than Full thickness of the aquifer

ROCKY MOUNTAIN ENERGY COMPANY

AQUIFER TEST DATA SHEET (2)

DATE 5/24/80 JOB DESCRIPTION Constant Rate

LOCATION Bear Creek

WELL NO. I12 TYPE observation for P10

COLLAR ELEVATION 2.0' T.C. above L.S.

TOTAL DEPTH FROM COLLAR ______ DIAMETER 5"

Under-Reamed 290-303 FT.

TRANSDUCER SERIAL NO. 40954 OFFSET 11.39

RANGE 25 SENSITIVITY 0.94

(TAPE DESCRIPTION) distance 44.7'

DATE	TIME hrs. min. sec.	MINUTES	BARO. READING (psi)	PRESSURE READING (psi)	TOTALIZED FLOW (gallons)	WATER LEVEL (ft.) (above probe)	DRAWDOWN (ft.)	t/t'
		0	4.20	51.49				
5-29-80	8:48	0	4.21	51.19		34.18	0	
		3.25		49.55			-1.01	
		4.25	4.22	48.99			1.33	
		6.5		48.00			1.54	
		8.5		47.32			2.35	
		12		46.61			2.79	
		16	4.22	46.18			3.05	
		20	4.23	45.92			3.19	
		25	"	45.76			3.29	
		30		45.64			3.36	
	*	45	4.25	45.43			3.45	
		57	"	45.45			3.43	
		65	"	45.39			3.47	
		75	"	45.32			3.51	
		92	4.25	45.16			3.61	
		100	4.25	45.13			3.63	
		120	4.26	44.99			3.69	
		140	"	44.92			3.74	
		170	4.26	44.83			3.79	
		195	4.27	44.78			3.80	
		225	"	44.69			3.85	
241	end	240	4.28	44.63			3.87	t/t'
	recovery	1		44.86			3.73	241
		2		45.83			3.13	121
		3		47.12			2.34	81
		4		47.85			1.89	61
		6		48.81			1.30	41

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ROCKY MOUNTAIN ENERGY COMPANY

AQUIFER TEST DATA SHEET (2)

DATE 5/29 JOB DESCRIPTION recovery

LOCATION Reno Creek

WELL NO. I 12 TYPE observation

COLLAR ELEVATION

TOTAL DEPTH FROM COLLAR DIAMETER 5"

SCREEN FROM FT. TO FT.

TRANSDUCER SERIAL NO. 40954 OFFSET

RANGE SENSITIVITY

(TAPE DESCRIPTION)

DATE	TIME hrs. min. sec.	MINUTES	BARO. READING (psi)	PRESSURE READING (psi)	TOTALIZED FLOW (gallons)	WATER LEVEL (ft.)	DRAWDOWN (ft.)	
		9		49.39			0.95	27.7
		17		49.68			0.77	15.1
		23		49.73			0.74	11.4

ROCKY MOUNTAIN ENERGY COMPANY

AQUIFER TEST DATA SHEET

DATE 5/29/80 JOB DESCRIPTION Constant Rate (page 1)

LOCATION Reno Creek - Pattern II

WELL NO. I13 TYPE observation for P10

COLLAR ELEVATION 2.0' T.C. above L.S.

TOTAL DEPTH FROM COLLAR ______ DIAMETER 5"

Under-Reamed 288-301 FT.

TRANSDUCER SERIAL NO. — OFFSET —

RANGE — SENSITIVITY —

(TAPE DESCRIPTION) measured by tape, W.L. 250.71' below M.P.

DATE	TIME hrs. min. sec.	MINUTES	BARO. READING (psi)	PRESSURE READING (psi)	TOTALIZED FLOW (gallons)	WATER LEVEL (ft.)	DRAWDOWN (ft.)	FLOW RATE (gpm)
	8:48 →	0				250.71	0	
5/29/80		5				250.93	0.22	
		9				251.09	0.38	
		13				251.25	0.54	
		36				252.11	1.40	
		56				252.80	2.09	
		112 / 120				254.46	3.75 / 3.92	
		210				256.57	5.86	
		238				257.01	6.30	

ROCKY MOUNTAIN ENERGY COMPANY

AQUIFER TEST DATA SHEET (4)

DATE 5/29/80 JOB DESCRIPTION Constant Rate
LOCATION Reno Creek - Pattern II
WELL NO. I14 TYPE observation for P10
COLLAR ELEVATION 1.7' T.C. above L.S.
TOTAL DEPTH FROM COLLAR ______ DIAMETER 5" yelowmine
Under-Reamed 293-304' FT. and 332-338' FT.
TRANSDUCER SERIAL NO. 40553 OFFSET +3.74
RANGE 100 SENSITIVITY 0.99
(TAPE DESCRIPTION) distance 24.5'

DATE	TIME hrs. min. sec.	MINUTES	BARO. READING (psi)	PRESSURE READING (psi)	TOTALIZED FLOW (gallons)	WATER LEVEL (ft.)	DRAWDOWN (ft.)	t/t'
		0	4.20	21.73		(above probe)		
5-29-80		0	4.21	21.76		51.77	0	
		3.33		20.30			3.41	
		4.5	4.22	20.09			3.90	
		7		19.88			4.36	
		9		19.81			4.53	
		12.5		19.76			4.64	
		16	4.22	19.72			4.74	
		20	4.23	19.70			4.76	
		26	"	19.69			4.78	
		30		19.67			4.83	
	x	45	4.25	19.59			4.97	
		57	"	19.57			5.02	
		65	"	19.56			5.04	
		75	"	19.54			5.09	
		92	4.25	19.51			5.16	
		100	"	19.50			5.18	
		120	4.26	19.48			5.20	
		140	"	19.45			5.27	
		170	4.26	19.42			5.34	
		195	4.27	19.42			5.32	
		225	"	19.40			5.37	
2:41	end	240	4.28	19.39			5.37	t/t'
	recovery	1		19.91			4.15	241
		2		20.76			2.17	121
		3		21.30			0.91	81
		4		21.45			0.56	61
		7		21.37			0.75	35.3

ROCKY MOUNTAIN ENERGY COMPANY

AQUIFER TEST DATA SHEET (4)

DATE 5/29 JOB DESCRIPTION recovery page 2
LOCATION Reno Creek
WELL NO. I14 TYPE observation for P10
COLLAR ELEVATION
TOTAL DEPTH FROM COLLAR DIAMETER 5"
SCREEN FROM FT. TO FT.
TRANSDUCER SERIAL NO. 40953 OFFSET
RANGE SENSITIVITY
(TAPE DESCRIPTION)

DATE	TIME hrs. min. sec.	MINUTES	BARO. READING (psi)	PRESSURE READING (psi)	TOTALIZED FLOW (gallons)	WATER LEVEL (ft.)	DRAWDOWN (ft.)	t/t'
		10		21.33			0.84	25
		16		21.34			0.82	16
		23		21.38			0.72	11.4

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ROCKY MOUNTAIN ENERGY COMPANY

AQUIFER TEST DATA SHEET (5)

DATE 5/29 JOB DESCRIPTION Constant Rate (page 1)

LOCATION Reno Creek - Pattern II

WELL NO. I15 TYPE observation for P10

COLLAR ELEVATION 1.5' T.C. above L.S.

TOTAL DEPTH FROM COLLAR ______ DIAMETER 5"

Under-Reamed 292 FT. TO 305 FT.

TRANSDUCER SERIAL NO. 40956 OFFSET 0.47

RANGE 100 SENSITIVITY 1.01

(TAPE DESCRIPTION) distance 25.7'

DATE	TIME hrs. min. sec.	MINUTES	BARO. READING (psi)	PRESSURE READING (psi)	TOTALIZED FLOW (gallons)	WATER LEVEL (ft.) (above Probe)	DRAWDOWN (ft.)	t/t'
		0	4.20	20.16				
		0	4.21	20.20		54.85	0	
		3.5		18.79			-3.22	
		4.75	4.22	18.59			3.66	
		7.5		18.39			4.12	
		9		18.35			4.21	
		13		18.29			4.35	
		16.5	4.22	18.26			4.41	
		20	4.23	18.26			4.39	
		26	"	18.22			4.48	
		30		18.21			4.51	
	*	45	4.25	18.12			4.66	
		57	"	18.13			4.64	
		65	"	18.13			4.64	
		75	"	18.12			4.66	
		92	4.25	18.10			4.71	
		100	"	18.08			4.76	
		120	4.26	18.06			4.78	
		140	"	18.04			4.82	
		170	4.26	18.01			4.89	
		195	4.27	18.00			4.89	
		225	"	17.99			4.92	
241	end	240	4.28	17.98			4.92	t/t'
	recovery	1.25		18.57			3.57	193
		2.25		19.32			1.85	107.7
		3		19.69			1.00	81
		4		19.91			0.50	61
		7		19.85			0.64	35.3

ROCKY MOUNTAIN ENERGY COMPANY

AQUIFER TEST DATA SHEET (5)

DATE 5/79 JOB DESCRIPTION recovery (page 2)
LOCATION Reno Creek
WELL NO. I15 TYPE observation for P10
COLLAR ELEVATION
TOTAL DEPTH FROM COLLAR DIAMETER 5"
SCREEN FROM FT. TO FT.
TRANSDUCER SERIAL NO. 40956 OFFSET
RANGE SENSITIVITY
(TAPE DESCRIPTION)

DATE	TIME hrs. min. sec.	MINUTES	BARO. READING (psi)	PRESSURE READING (psi)	TOTALIZED FLOW (gallons)	WATER LEVEL (ft.)	DRAWDOWN (ft.)	t/t'
		11		19.81			0.73	22.8
		15		19.82			0.71	17
	end	23		19.86			0.62	11.4

ROCKY MOUNTAIN ENERGY COMPANY

AQUIFER TEST DATA SHEET

DATE 5-29-80 JOB DESCRIPTION Constant Rate

LOCATION Reno Creek

WELL NO. M16 TYPE Monitor Well for P10

COLLAR ELEVATION 1.5' T.C. above L.S.

TOTAL DEPTH FROM COLLAR ______ DIAMETER 5" yellowmine

SCREEN FROM 262 FT. TO 374 FT.

TRANSDUCER SERIAL NO. — OFFSET —

RANGE — SENSITIVITY —

(TAPE DESCRIPTION) W.L. 264.70' below M.P., Meas. w/ elec tape

DATE	TIME hrs. min. sec.	MINUTES	BARO. READING (psi)	PRESSURE READING (psi)	GAUGE PRESSURE (psi)	WATER LEVEL (ft.)	DRAWDOWN (ft.)	FLOW RATE (gpm)
5-29-80	8:30	0				264.70		
	8:48	0				264.70	0	
		28				264.84	0.14	
		85				265.12	0.42	
		135				265.24	0.54	
		196				265.30	0.60	

ROCKY MOUNTAIN ENERGY COMPANY

AQUIFER TEST DATA SHEET

DATE 5-29-80 JOB DESCRIPTION Constant Rate

LOCATION Reno Creek -- Pattern II

WELL NO. M17 TYPE Monitor Well For P10

COLLAR ELEVATION 1.4' T.C. above L.S.

TOTAL DEPTH FROM COLLAR ______ DIAMETER 5" yelomine

SCREEN FROM 269 FT. TO 377 FT.

TRANSDUCER SERIAL NO. — OFFSET ______

RANGE ______ SENSITIVITY ______

(TAPE DESCRIPTION) Meas. w/ elec. Tape

DATE	TIME hrs. min. sec.	MINUTES	BARO. READING (psi)	PRESSURE READING (psi)	TOTALIZED FLOW (gallons)	WATER LEVEL (ft.)	DRAWDOWN (ft.)	FLOW RATE (gpm)
5-29-80	8:35	0				265.06		
	8:48	0				265.06	0	
		44				265.21	0.15	
		88				265.29	0.23	
		139				265.37	0.31	
		201				265.45	0.39	

ROCKY MOUNTAIN ENERGY COMPANY

AQUIFER TEST DATA SHEET

DATE 5-29-80 JOB DESCRIPTION Constant Rate

LOCATION Reno Creek -- Pattern II

WELL NO. M18 TYPE Monitor Well For P10

COLLAR ELEVATION 1.4' T.C. above G.S.

TOTAL DEPTH FROM COLLAR ______ DIAMETER 5" yelomine

SCREEN FROM 258 FT. TO 378 FT.

TRANSDUCER SERIAL NO. — OFFSET ______

RANGE ______ SENSITIVITY ______

(TAPE DESCRIPTION) Meas. w/ elec. Tape

DATE	TIME hrs. min. sec.	MINUTES	BARO. READING (psi)	PRESSURE READING (psi)	TOTALIZED FLOW (gallons)	WATER LEVEL (ft.)	DRAWDOWN (ft.)	FLOW RATE (gpm)
5-29-80	8:40	0				260.91		
	8:48	0				260.91	0	
		48				261.07	0.16	
		93				261.12	0.21	
		143				261.29	0.38	
		205				261.33	0.42	

ROCKY MOUNTAIN ENERGY COMPANY

AQUIFER TEST DATA SHEET

DATE 5-29-80 JOB DESCRIPTION Constant Rate
LOCATION Reno Creek -- Pattern II
WELL NO. M19 TYPE Monitor Well For P10
COLLAR ELEVATION 1.4' T.C. above L.S
TOTAL DEPTH FROM COLLAR ______ DIAMETER 5" yelomine
SCREEN FROM 257 FT. TO 253 FT.
TRANSDUCER SERIAL NO. — OFFSET ______
RANGE ______ SENSITIVITY ______
(TAPE DESCRIPTION) Meas. w/ elec. tape

DATE	TIME hrs. min. sec.	MINUTES	BARO. READING (psi)	PRESSURE READING (psi)	TOTALIZED FLOW (gallons)	WATER LEVEL (ft.)	DRAWDOWN (ft.)	FLOW RATE (gpm)
5-29-80	8:25	0				259.05		
	8:48	0				259.05	0	
		22				259.11	0.06	
		79				259.37	0.32	
		129				259.54	0.49	
		190				259.51	0.46	
		234				259.55	0.50	

ROCKY MOUNTAIN ENERGY COMPANY

AQUIFER TEST DATA SHEET

DATE 5·29·80 JOB DESCRIPTION Constant Rate

LOCATION Reno Creek - Pattern II

WELL NO. USM-2 TYPE Monitor Well For P10

COLLAR ELEVATION 1.9' T.C. above L.S.

TOTAL DEPTH FROM COLLAR ______ DIAMETER 5" yelomine

Under-Reamed 150 FT. TO 190 FT.

TRANSDUCER SERIAL NO. — OFFSET ______

RANGE ______ SENSITIVITY ______

(TAPE DESCRIPTION) Meas. w/elec. tape

DATE	TIME hrs. min. sec.	MINUTES	BARO. READING (psi)	PRESSURE READING (psi)	TOTALIZED FLOW (gallons)	WATER LEVEL (ft.)	DRAWDOWN (ft.)	FLOW RATE (gpm)
5·29·80	8:20	0				260.30		
	8:48	0				260.31	0	
		17				260.31	0	
		73				260.31	0	
		125				260.31	0	
		187				260.31	0	

ROCKY MOUNTAIN ENERGY COMPANY

AQUIFER TEST DATA SHEET

DATE 5-29-80 JOB DESCRIPTION Constant Rate

LOCATION Reno Creek - Pattern II

WELL NO. LSM-2 TYPE Monitor Well For P10

COLLAR ELEVATION 2.0' T.C. above L.S.

TOTAL DEPTH FROM COLLAR ______ DIAMETER 5" yelomine

Under-Reamed 400-440 FT.

TRANSDUCER SERIAL NO. — OFFSET ______

RANGE ______ SENSITIVITY ______

(TAPE DESCRIPTION) measured by elec. tape

DATE	TIME hrs. min. sec.	MINUTES	BARO. READING (psi)	PRESSURE READING (psi)	GAUGE PRESSURE (psi)	WATER LEVEL (ft.)	DRAWDOWN (ft.)	FLOW RATE (gpm)
	8:20	0				260.30		
	8:48	0				260.31	0	
		17				260.31	0	
		73				260.31	0	
		125				260.31	0	
		187				260.31	0	

/

ROCKY MOUNTAIN ENERGY COMPANY

AQUIFER TEST DATA SHEET

DATE 5/28/80 JOB DESCRIPTION Injection
LOCATION Reno Creek
WELL NO. I 12 TYPE Injection on I 12
COLLAR ELEVATION
TOTAL DEPTH FROM COLLAR DIAMETER
SCREEN FROM FT. TO FT.
TRANSDUCER SERIAL NO. 40947 OFFSET 1.40
RANGE 100 SENSITIVITY 0.99
(TAPE DESCRIPTION)

DATE	TIME hrs. min. sec.	MINUTES	BARO. READING (psi)	PRESSURE READING (psi)	TOTALIZED FLOW (gallons)	WATER LEVEL (ft.)	DRAWDOWN (ft.)	FLOW RATE (gpm)
	9:53	0	4.23	4.96	18.08		0	
		0.25		5.30			0.79	
		0.50		5.50			1.26	
		0.75		5.67			1.66	
		1.0		6.39			3.34	
		2		9.22			9.94	11.29
		3		10.13			12.06	11.34
		4		10.95			13.98	
		5		11.66			15.63	
		6		12.37			17.29	11.37
		7		13.13			19.06	
		8		14.00			21.09	
		9		15.12			23.71	
flow stopped	11 [illegible]	10		16.59			27.18	11.48
		15	4.25	26.19			49.58	
		19		32.72			64.82	
		20		34.02			67.85	
		25		38.58			78.49	11.29
		30		40.84			83.77	11.32
		35	4.26	41.77			85.89	
		42		42.33			87.27	
		50	4.26	43.68			88.08	11.32
		86	4.29	43.87			90.93	11.42
		94	"	43.87			90.93	11.37
		100	4.29	43.88			90.95	

ROCKY MOUNTAIN ENERGY COMPANY

AQUIFER TEST DATA SHEET

DATE 5/28 JOB DESCRIPTION Injection
LOCATION Reno Creek
WELL NO. P10 TYPE Observation for I12
COLLAR ELEVATION
TOTAL DEPTH FROM COLLAR DIAMETER
SCREEN FROM FT. TO FT.
TRANSDUCER SERIAL NO. 40954 OFFSET +11.39
RANGE 25 SENSITIVITY 0.94
(TAPE DESCRIPTION)

DATE	TIME hrs. min. sec.	MINUTES	BARO. READING (psi)	PRESSURE READING (psi)	TOTALIZED FLOW (gallons)	~~WATER LEVEL~~ (ft.)	DRAWDOWN (ft.)	FLOW RATE (gpm)
		0	4.23	28.72		20.42	0	
		1.25		28.81			+0.06	
		2.33		29.25			.33	
		3.33		29.70			.60	
		5.25		30.52			1.11	
		8.25		31.12			1.47	
		11		31.10			1.46	
		15.5	4.25	30.87			1.37	
		19.5		30.99			1.44	
		25		31.31			1.64	
		34		31.64			1.84	
		42		31.75			1.91	
	dropping	52	4.26	31.89			2.02	
		88	4.29	31.76			2.01	
		95	..	31.73			1.99	
		100		31.71			1.98	

ROCKY MOUNTAIN ENERGY COMPANY

AQUIFER TEST DATA SHEET

DATE 5/28 JOB DESCRIPTION Injection

LOCATION Bens Creek

WELL NO. I14 TYPE Observation for I12

COLLAR ELEVATION

TOTAL DEPTH FROM COLLAR DIAMETER

SCREEN FROM FT. TO FT.

TRANSDUCER SERIAL NO. 40953 OFFSET +3.74

RANGE 100 SENSITIVITY 0.99

(TAPE DESCRIPTION)

DATE	TIME hrs. min. sec.	MINUTES	BARO. READING (psi)	PRESSURE READING (psi)	TOTALIZED FLOW (gallons)	~~WATER LEVEL~~ (ft.)	DRAWDOWN (ft.)	FLOW RATE (gpm)
		0	4.23	21.66		51.58	0.00	
		1.33		21.66			0	
		2.5		21.70			+0.09	
		3.5		21.80			0.33	
		5.5		21.94			0.65	
		8.5		22.05			0.91	
		11.5		22.05			0.91	
		16	4.25	22.02			0.89	
		20		22.03			0.91	
		25.5		22.09			1.05	
		34		22.14			1.17	
		43		22.16			1.21	
		51	4.26	22.24			1.42	
		88	4.29	22.19			1.38	
		95	〃	22.21			1.42	
		100		22.19			1.35	

ROCKY MOUNTAIN ENERGY COMPANY

AQUIFER TEST DATA SHEET

DATE 5/28 JOB DESCRIPTION Injection
LOCATION
WELL NO. I 15 TYPE observation for I 12
COLLAR ELEVATION
TOTAL DEPTH FROM COLLAR DIAMETER
SCREEN FROM FT. TO FT.
TRANSDUCER SERIAL NO. 40956 OFFSET 0.47
RANGE 100 SENSITIVITY 1.01
(TAPE DESCRIPTION)

DATE	TIME hrs. min. sec.	MINUTES	BARO. READING (psi)	PRESSURE READING (psi)	TOTALIZED FLOW (gallons)	~~WATER LEVEL~~ (ft.)	DRAWDOWN (ft.)	FLOW RATE (gpm)
		0	4.23	19.94		54.30	0	
		1.5		20.01			+0.16	
		2.75		20.18			0.55	
		3.75		20.31			0.85	
		5.75		20.50			1.28	
		8.75		20.59			1.49	
		11.75		20.54			1.37	
		17	4.25	20.50			1.33	
		20		20.54			1.42	
		25.5		20.61			1.58	
		34		20.69			1.76	
		44		20.72			1.83	
		51	4.26	20.68			1.76	
		85	4.25	20.61			1.81	
		95		20.69			1.85	
		100		20.67			1.81	

ROCKY MOUNTAIN ENERGY COMPANY

AQUIFER TEST DATA SHEET

DATE 5/28 JOB DESCRIPTION Injection
LOCATION Reno Creek
WELL NO. I13 TYPE Injector
COLLAR ELEVATION
TOTAL DEPTH FROM COLLAR DIAMETER
SCREEN FROM FT. TO FT.
TRANSDUCER SERIAL NO. 40947 OFFSET 1.40
RANGE 100 SENSITIVITY 0.55
(TAPE DESCRIPTION)

DATE	TIME hrs. min. sec.	MINUTES	BARO. READING (psi)	PRESSURE READING (psi)	GAUGE PRESSURE (psi)	WATER LEVEL (ft.)	DRAWDOWN (ft.)	FLOW RATE (gpm)
		0	4.36	37.18				
		0		36.72	92.48		0	17.92
		1		41.07			+ 10.15	
		2		48.44			27.35	
		3.25		57.50			48.49	
		4		62.91			61.11	
		5	4.37	70.17			78.07	
		6		77.39			94.92	17.98
		8		91.74			128.45	
		9		99.0			145.34	

Exceeded transducer capacity
overflowed casing
acceptable injection rate ≈ 1/2 gpm

Volume of casing 255 gal
- pump at 18 gpm for ≈ 14 minutes

ROCKY MOUNTAIN ENERGY COMPANY

AQUIFER TEST DATA SHEET

DATE 5/24 JOB DESCRIPTION Injection
LOCATION Reno Creek
WELL NO. I14 TYPE injection
COLLAR ELEVATION
TOTAL DEPTH FROM COLLAR DIAMETER
SCREEN FROM FT. TO FT.
TRANSDUCER SERIAL NO. 40553 OFFSET 3.74
RANGE 100 SENSITIVITY 0.95
(TAPE DESCRIPTION)

DATE	TIME hrs. min. sec.	MINUTES	BARO. READING (psi)	PRESSURE READING (psi)	TOTALIZED FLOW (gallons)	WATER LEVEL (ft.)	DRAWDOWN (ft.)	FLOW RATE (gpm)
	1:54	0	4.32	21.90		52.35	0	17.86
		1		24.17			+ 5.3	
		2		28.00			14.23	
		3		29.93			18.74	
		4		30.93			21.07	
		5	"	31.62			22.68	
		6		32.28			24.22	17.77
		7	"	32.94			25.76	
		8		33.58			27.25	
		9		34.16			28.61	17.81
		10	"	34.67			29.80	17.88
		12	"	35.29			31.24	
		14	4.34	35.62			32.06	17.89
		16	4.35	35.85			32.62	
		18	"	36.12			33.25	17.83
		21	"	36.53			34.21	
		25	"	36.98			35.26	
		30	"	37.41			36.26	17.76
		35	"	37.73			37.01	17.70
		40	"	38.08			37.82	
		50	4.36	38.71			39.32	17.81
		60	4.40	39.37			40.95	17.79
		70	"	39.87			42.12	17.74
		80	"	40.32			43.17	17.64
		90	4.37	40.79			44.19	17.56
		100	4.38	41.47			+ 45.80	17.66

(2)

ROCKY MOUNTAIN ENERGY COMPANY

AQUIFER TEST DATA SHEET

DATE 5·28·80 JOB DESCRIPTION Injection
LOCATION Reno Creek·· Pattern 2
WELL NO. P10 TYPE Observation Well For I14
COLLAR ELEVATION
TOTAL DEPTH FROM COLLAR DIAMETER
SCREEN FROM FT. TO FT.
TRANSDUCER SERIAL NO. 40954 OFFSET 11.39
RANGE 25 psi SENSITIVITY 0.94
(TAPE DESCRIPTION)

DATE	TIME hrs. min. sec.	MINUTES	BARO. READING (psi)	PRESSURE READING (psi)	TOTALIZED FLOW (gallons)	WATER LEVEL (ft.)	DRAWDOWN (ft.)	FLOW RATE (gpm)
5·28·80		0	4.32	30.02		21.42	0	
		1.25		30.29			0.17	
		2.25		31.68			1.02	
		3.0		32.93			1.79	
		4.5		34.53			2.77	
		5.5	"	35.20			3.18	
		6.5		35.60			3.43	
		7.5	"	35.86			3.59	
		8.5		36.07			3.72	
		9.5		36.21			3.80	
		11		36.44			3.94	
		13		36.68			4.09	
		15	4.35	36.83			4.25	
		17		36.94			4.32	
		20	"	37.03			4.38	
		24	"	37.08			4.41	
		30	"	37.16			4.46	
		35	"	37.20			4.48	
		40	"	37.24			4.50	
		50	4.36	37.29			4.56	
		60	4.40	37.33			4.68	
		70	"	37.38			4.71	
		80	"	37.41			4.72	
		90	4.37	37.44			4.67	
		100	4.38	37.42			4.68	

ROCKY MOUNTAIN ENERGY COMPANY

AQUIFER TEST DATA SHEET

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DATE 5-28-80 JOB DESCRIPTION Injection

LOCATION Reno Creek·· Pattern 2

WELL NO. I15 TYPE Injector

COLLAR ELEVATION

TOTAL DEPTH FROM COLLAR DIAMETER

SCREEN FROM FT. TO FT.

TRANSDUCER SERIAL NO. 40956 OFFSET 0.47

RANGE 100 psi SENSITIVITY 1.01

(TAPE DESCRIPTION)

DATE	TIME hrs. min. sec.	MINUTES	BARO. READING (psi)	PRESSURE READING (psi)	TOTALIZED FLOW (gallons)	WATER LEVEL (ft.)	DRAWDOWN (ft.)	FLOW RATE (gpm)
5-28-80	11:59	0	4.30	20.12		54.88	0	17.9
		1		22.43			5.28	
		2		25.57			12.46	17.83
		3		26.76			15.19	
		4		27.28			16.38	17.86
		6		27.86			17.70	
		11	4.30	28.85			19.97	
		15		29.49			21.43	17.85
		22		29.99			22.57	
		38	4.31	30.98			24.86	17.76
		54	"	31.60			26.28	17.74
		70		32.18			27.61	17.70
higher flow @ end		94	4.32	33.25			30.08	17.96

ENG FORM 160

ROCKY MOUNTAIN ENERGY COMPANY

AQUIFER TEST DATA SHEET

DATE 5/28 JOB DESCRIPTION Injection

LOCATION Reno Creek

WELL NO. P10 TYPE observation for I15

COLLAR ELEVATION

TOTAL DEPTH FROM COLLAR DIAMETER

SCREEN FROM FT. TO FT.

TRANSDUCER SERIAL NO. #54 OFFSET 11.39

RANGE 25 psi SENSITIVITY 0.94

(TAPE DESCRIPTION)

DATE	TIME hrs. min. sec.	MINUTES	BARO. READING (psi)	PRESSURE READING (psi)	GAUGE PRESSURE (psi)	~~WATER LEVEL~~ (ft.)	DRAWDOWN (ft.)	FLOW RATE (gpm)
		0	4.30	29.76		21.22	0	
		1.5		30.30			+0.33	
		5		34.47			2.89	
		11	4.30	35.86			3.75	
		22		36.18			3.94	
		40		36.46			4.12	
		54		36.57			4.18	
		70		36.64			4.23	
		94		36.74			+ 4.29	

ENG FORM 160

ROCKY MOUNTAIN ENERGY COMPANY

AQUIFER TEST DATA SHEET

DATE 5/28 JOB DESCRIPTION injection

LOCATION Reno Creek

WELL NO. I12 TYPE observation for I15

COLLAR ELEVATION

TOTAL DEPTH FROM COLLAR DIAMETER

SCREEN FROM FT. TO FT.

TRANSDUCER SERIAL NO. 47 OFFSET 1.40

RANGE 100 SENSITIVITY 0.99

(TAPE DESCRIPTION)

DATE	TIME hrs. min. sec.	MINUTES	BARO. READING (psi)	PRESSURE READING (psi)	GAUGE PRESSURE (psi)	~~LEVEL~~ WATER (ft.)	DRAWDOWN (ft.)	FLOW RATE (gpm)
		0	4.30	8.80		27.20	0.0	
		5		7.52			-2.99	
		11	4.30	7.01			-4.18	
		22		6.66			-4.99	
		40		6.60			-5.13	
		54		6.61			-5.11	
		70		6.62			-5.09	
		94		6.63			-5.06	

ROCKY MOUNTAIN ENERGY COMPANY

AQUIFER TEST DATA SHEET

DATE 5/28 JOB DESCRIPTION

LOCATION

WELL NO. I 14 TYPE observation for I 15

COLLAR ELEVATION

TOTAL DEPTH FROM COLLAR DIAMETER

SCREEN FROM FT. TO FT.

TRANSDUCER SERIAL NO. 40553 OFFSET +3.74

RANGE 100 SENSITIVITY 0.99

(TAPE DESCRIPTION)

DATE	TIME hrs. min. sec.	MINUTES	BARO. READING (psi)	PRESSURE READING (psi)	GAUGE PRESSURE (psi)	~~WATER LEVEL~~ (ft.)	DRAWDOWN (ft.)	FLOW RATE (gpm)
		0	4.30	21.83		52.14	0	
		1.25		21.85			+0.05	
		5.0		22.67			1.96	
		11	4.30	23.00			2.73	
		22		23.07			2.89	
		40		23.13			3.03	
		54		23.16			3.10	
		70		23.18			3.15	
		94	4.32	23.19			+3.22	